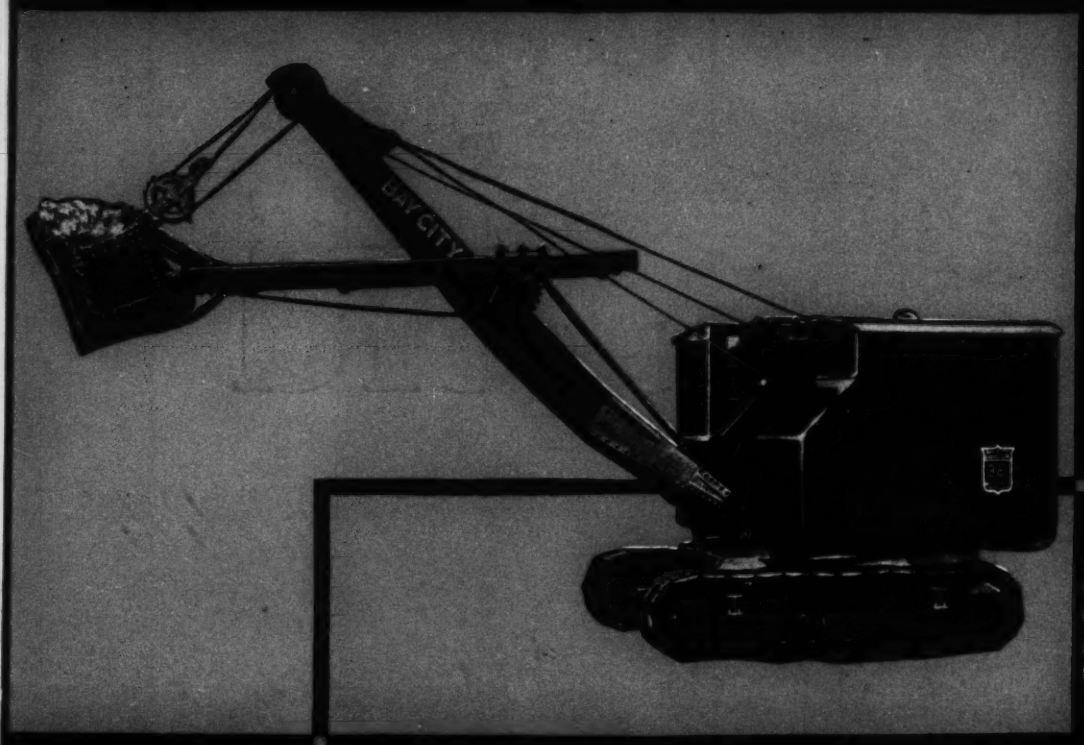
MAY 20 1935

Engineering News-Record

McGraw-Hill Publishing Company, Inc. May 16, 1935 Twenty-five Cents. Five Dollars per Year

Preparing the power house site as concreting for TVA's Norris Dam goes on over head



Bay City Shovels, powered by "Caterpillar" Diesel Engines, are offered in sizes from ⅜ to 1¼ yard capacity.

BAY CITY CHOSE . . . ON THE SHOW-DOWN

"Caterpillar" sales engineers laid their facts and figures before Bay City Shovels, Inc., of Bay City, Michigan . . . showed how the design of "Caterpillar" Diesel Engines fits them for shovel work . . . gave proof of economy, endurance, low maintenance cost. As a result, Bay City now offers its shovels, cranes and draglines powered with "Caterpillar" Diesel Engines . . . so also have some 30 other manufacturers. Get the complete story. Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR

REG. U. S. PAT. OFF.

DIESEL

Recovery Is in Process

ON one point both the President and the severest critics of his New Deal seem to be agreed: recovery actually is in process. Their differences are found in the President's contention that the critics themselves are obstructing a full measure of recovery by their lack of initiative and courage, while the critics insist that the President's efforts in behalf of reform are inhibiting the enterprise that otherwise might achieve a revival.

Here there is no need to debate the issue thus joined; that is in process eleswhere in ample volume. But for the moment it would be worth while to concentrate on the fact of the agreement that recovery is in process.

During the last few years this page has tried from time to time to criticize constructively those policies and measures that might have a bearing on the operations of construction and its allied industries. Naturally, therefore, its efforts have been directed, for the most part, toward the correction of tendencies that might curtail the contribution of those industries toward recovery. But however useful may be the function of the critic or the crusader, he always is in danger of overlooking the results actually achieved and of bearing down too heavily on shortcomings or on the need for further progress. It is worth while, now and then, for him to take time out to adjust his appraisals to conditions as they are.

THIS page is written during a trip through the middle west in the course of which the writer has had a chance to confer with a number of men engaged in a variety of industries. More than ever it becomes manifest that general recovery really is under way. This does not mean that everyone is happy; neither is anyone altogether content. But almost everyone reports better business than last year and many have renewed their acquaintance with profits. Some are frankly enthusiastic as to both progress and prospects; none is whipped and despondent.

It would be worth while for each of us to keep this trend in mind, even though the full fruits of revival may not yet have come to all of us. It is to be expected that, aside from public works operations, construction is likely to lag somewhat behind general recovery. Yet even private construction has shown during recent months a heartening upturn. With a continuance of general recovery, a vast accumulated shortage of capital plant to be made up, a very low interest rate, and with the support meanwhile of a governmental works program, we have every reason to expect that construction will hold its place and play its part in the march back to better business.

ABOVE all should we beware of letting a preoccupation with our specific and immediate difficulties blind us to the vital fact of general revival. We cannot afford to take counsel either of our own misgivings or of the croakings of those who for partisan purpose would put the worst face on conditions. Neither can we afford to sit disconsolate, waiting for the tide of recovery to reach us and to float us off, despite ourselves, to a fairer shore. It won't happen that way. For there are those who will dare struggle out to meet it and who will supplement its natural strength by their own efforts. It is these who today are first tasting the flavor of recovery.

As one industrialist put it the other day, we shall have to "stimulate our selling glands," and bestir ourselves to catch the tide of recovery through our own aggressive effort. Certainly the least that any of us can do is to lay off the calamity howling, recognize the trend for the better and set out to sell our goods with a spirit that will beget confidence because it is itself born of confidence.

And what recovery there may be today and tomorrow will belong to those who are following just that policy.

Willard Chevalier

NRA CODE

ENGINEERING NEWS-RECORD

Published every Thursday. Vol. 114, No. 20. Price 25c. per copy. Subscription, domestic, Mexico, Central and South American countries, $5 per year. Canada, including duty, $7.50. All other countries $9 a year or 36 shillings. Entered as second-class matter April 11, 1917, at the Postoffice at New York, N. Y., under the Act of March 3, 1879. Printed in U.S.A. Cable Address "McGrawhill, New York." Member A.B.P. Member A.B.C. Copyright 1935 by

McGRAW-HILL PUBLISHING COMPANY, INC., 330 WEST 42d STREET, NEW YORK, N. Y.

Editorial and Publishing Offices: 330 West 42d Street, New York; 520 North Michigan Avenue, Chicago; 883 Mission Street, San Francisco; Aldwych House, London, W. C. 2, England. Branch Offices: Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Greenville, S. C.

JAMES H. McGRAW, Chairman of the Board — WILLARD CHEVALIER, Vice-President — JAMES H. McGRAW, JR., Vice-Pres. and Treas.
MALCOLM MUIR, President — B. R. PUTNAM, Secretary.

Printed by The Schweinler Press, N. Y.

Table of Contents—See Page 27

DARK COLORED SHEET CONCRETE PAVING ON MEADOWBROOK PARKWAY, L. I.

MORE THAN 200,000 SQUARE YARDS OF DARK COLORED CONCRETE PAVING UNDER CONSTRUCTION ON LONG ISLAND

Dark Colored Concrete Paving is Safe . . .
Glare is eliminated both day and night . . .
White safety Lines are accentuated . . .
It has all the non-skid qualities of
Concrete—and a superior appearance!

Dark Colored Concrete is made simply, economically, effectively, by adding Emulsified Carbon Black to the top mix—either by the Sheet Concrete method or by coloring concrete above the plane of reinforcing. Two Brands of Emulsified Carbon Black meet or surpass State Highway Specifications.

BINNEY & SMITH CO.
41 EAST 42nd STREET
NEW YORK CITY
Makers of
HiBlak

EMULSIFIED CARBON BLACKS

GODFREY L. CABOT, Inc.
77 FRANKLIN STREET
BOSTON, MASS.
Makers of
CHARON

ENGINEERING NEWS-RECORD

Editorial Staff
V. T. Boughton
W. G. Bowman
Chicago
W. W. De Berard

McGraw-Hill Publishing Co., Inc. Editorial and Publishing Offices: 330 West 42d St., New York

F. E. SCHMITT, *Editor* WILLARD CHEVALIER, *Vice-President*

Editorial Staff
C. S. Hill
H. W. Richardson
San Francisco
N. A. Bowers

CONTENTS FOR MAY 16, 1935

VOLUME 114 NUMBER 20 COPYRIGHT 1935

Metal Culverts for Lake Okeechobee Levees. 693

Elastic-Wire Strain Meter Improvements.... 696
BY R. W. CARLSON

Fatigue Tests of Reinforced-Concrete Beams. 697

High Speed in Concreting at Norris Dam..... 698

Tall Timber Radio Tower in Richmond..... 701
BY FRANK P. CARTWRIGHT

Engineers' Part in Indiana's CCC Program... 703
BY DENZIL DOGGETT

Soil Surveys for New Hampshire Highways... 706
BY JOHN O. MORTON

Maryland's Ten-Year Road Program..... 709

Local Coordination for Code Administration. 711

Report of AWWA Meeting in Cincinnati..... 713

Letters to the Editor..... 716

Editorials 718

Current News 720

Construction Equipment and Materials..... 726

In the News:

NO NEWS is said to be good news, but that theory does not apply to news of the allotments from the relief-works fund. Valuable weeks are slipping by while the Washington authorities continue to mark time. Even highway and grade-crossing elimination work, of which there are many millions of dollars ready for contract, does not get definite allotments.

MONEY TO GO AHEAD with the TVA program on its present large scale is not forthcoming from Congress without a struggle. Some Congressmen are beginning to inquire as to how the money is being spent and why.

WHILE of no immediate importance to the construction industry, the Supreme Court's disapproval of the Railroad Retirement Act is of indirect interest because of its possible effect upon the federal social security legislative program and other matters affecting hours and wages. The decision appears bound to check the federal program, transferring much of the initiatory work to the states.

THREE PWA HOUSING PROJECTS opened bids last week. In Cleveland, the low bidder on the Cedar-Central project was the George A. Fuller Co., Washington, D. C.—$2,517,000. In Indianapolis the low bidder was the N. P. Severin Co., Chicago —$2,190,000. In Montgomery, Ala., T. L. James, Longview, Tex., was low at $374,-300. Two projects are under construction at Atlanta.

INDUSTRY began to get its cut of the new relief-works funds last week when Robert Fechner, director of emergency conservation work, approved the purchase for the CCC of 4,565 trucks, 100 passenger cars, 60 air compressors, 200 rock drills, 180 tractors, 50 trail-builders, 20 bulldozers, 100 concrete mixers, 30 rock crushers, 100 graders, 20 gas shovels, 10 draglines and 30 truck shovels.

In This Issue:

A DIFFICULT foundation problem, that of providing safe foundations for large concrete culverts on soft ground, was solved in the construction of the levees around Lake Okeechobee by substituting metal pipe for concrete boxes.

UNCERTAIN RESULTS and frequently complete failure of some of the earlier types of elastic-wire strain meters have been largely eliminated as the result of five years' experience in the development of these measuring devices.

THE CURRENT RATE OF CONCRETING AT NORRIS DAM is consistently ahead of the most optimistic expectations of the designers. Part of this is due to the concrete plant, but a large part also is due to the type of forms used and to the form-handling and concrete-placing equipment, which are described in this issue.

AN UNGUYED WOODEN RADIO TOWER 320 ft. high has been built at Richmond, Va., as the result of recent developments in methods of timber fabricating. An innovation is that it is triangular in plan, permitting economy in material and simplicity in framing.

TYPICAL OF THE PART that engineers are called upon to do or should be asked to do in connection with CCC operations is the work in Indiana. The expanded program this year should call for an increased number of engineers if the work is efficiently handled.

SOIL SURVEYS carried on by the New Hampshire highway department are proving to be an important aid to highway design and maintenance.

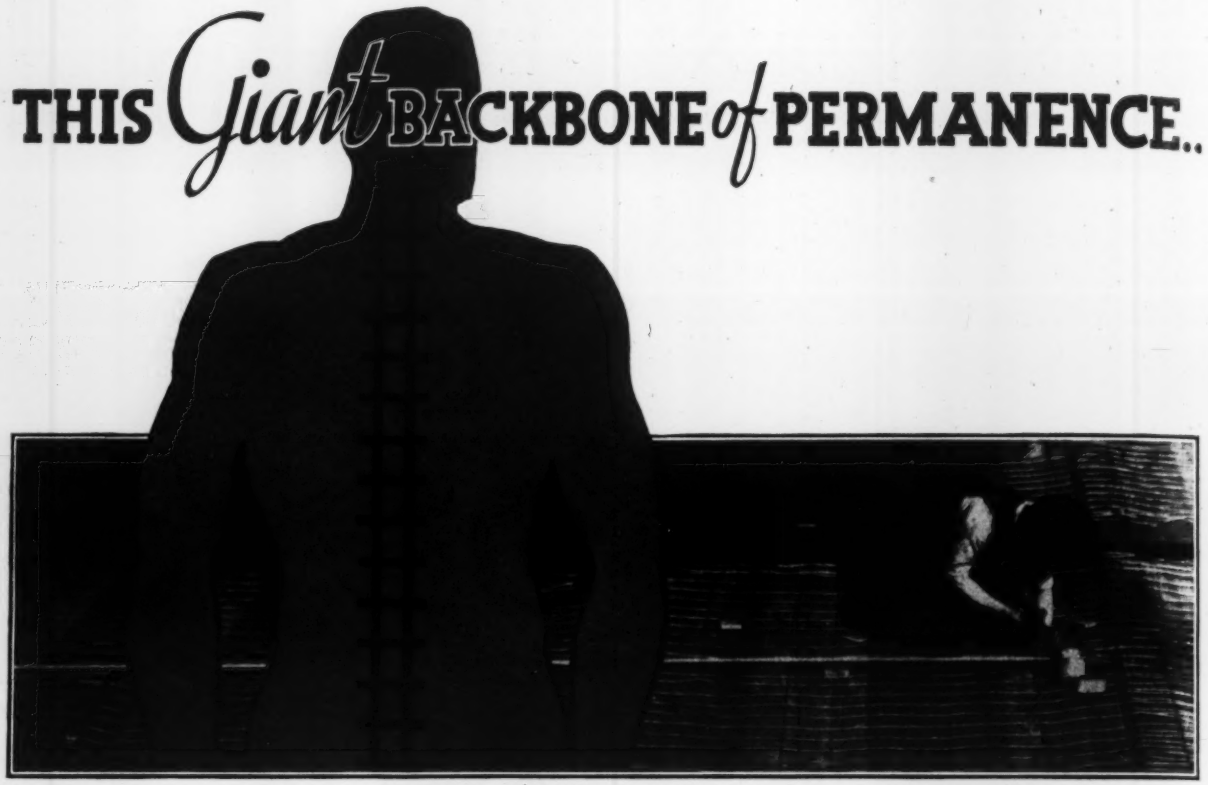
THE COVER

The picture on the cover of this week's issue, in addition to showing the remarkable progress on Norris Dam, is of interest in that it caught two instrumentmen—typical engineers to the layman—in the act of doing their bit on the big job of building that dam. Possibly it is only one instrumentman, the man with the level on his shoulder may be a rodman; for, as we recall, the rodman always offered to carry the gun when pictures were being taken.

WATERWORKS REPORT

The annual convention of the American Water Works Association in Cincinnati last week broke records: better attendance than last year's meeting in New York; strongest program in several years; and best display of equipment and materials since before the recent unpleasantness of a depression. A complete report appears in this issue.

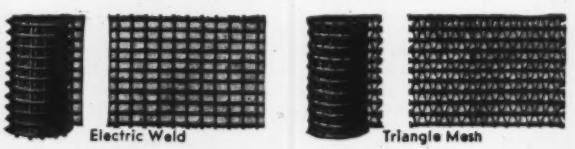
THIS *Giant* BACKBONE *of* PERMANENCE..



. . . IS EASY TO HANDLE

BUILD for tomorrow—but in building for the future, do not overlook today's need for speed and economy in floor slab construction. In this connection—you will find American Steel & Wire Company Wire Fabric the ideal reinforcement material. Available in rolls—it is exceptionally easy to handle—and keeps labor costs down to a minimum. This Wire Fabric —of highest quality and perfected design—reinforces the concrete slab in every direction. It provides continuous action from one end of the structure to the other —plus high elastic limits and ultimate tensile strength due to cold drawing. It is truly called "The Giant Backbone of Permanence." Interesting literature is available covering the use of this material in the nation's leading structures. This—along with technical data—will be forwarded on request.

FURNISHED IN ROLLS OR SHEETS



AMERICAN STEEL & WIRE COMPANY

WIRE FABRIC

THE STEEL BACKBONE OF CONCRETE

AMERICAN STEEL & WIRE COMPANY

208 S. LA SALLE STREET, CHICAGO • • EMPIRE STATE BUILDING, NEW YORK

Offices in All Principal Cities

Pacific Coast Distributors: Columbia Steel Company, Russ Building, San Francisco

Export Distributors: United States Steel Products Company, New York

United States Steel Corporation Subsidiary

ENGINEERING NEWS-RECORD

May 16, 1935

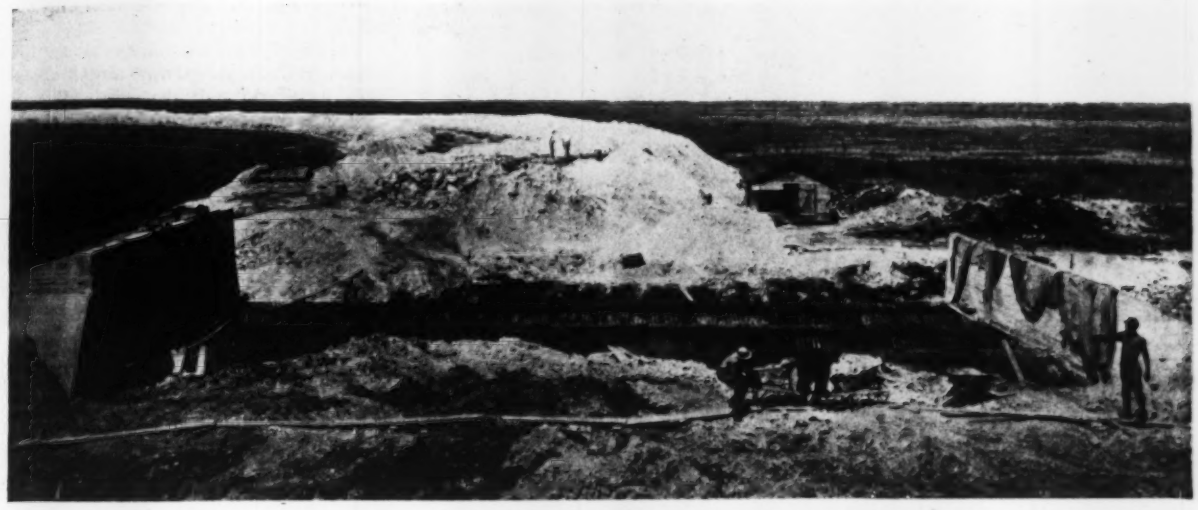


FIG. 1—CULVERT of three 10-ft.-diameter pipes under construction through Lake Okeechobee ring levee, shown partly completed in the background with lake on the left and swamp on the right.

Metal Culvert Construction for Lake Okeechobee Levees

Heavy pile foundations avoided—Climatic and water conditions required special non-corrosive quality of pipe and fixtures and heavy bituminous protection

CONSTRUCTION of 66 miles of levees along the shores of Lake Okeechobee at the northern end of the Florida Everglades (*ENR*, Aug. 16, 1934, p. 195), to protect adjacent lands from overflows from that body of water due to hurricanes or other extreme conditions, requires the provision of thirteen sets of one to six 10-ft. internal-diameter culverts through which water may be drawn from or pumped into the lake. These culverts have in all 30 pipes totaling 3,395 lin.-ft. They are separate and distinct from six hurricane gates that also are being built as controlling works at the entrances through the levees to as many outlets into overflow and drainage canals leading from the lake to the Atlantic or to the Gulf of Mexico. Various functions may from time to time be performed by the culverts.

Functions of culverts

Under certain conditions the culverts may be used as inlets from the lake to pumping stations lifting water for irrigation of the Everglades after drainage of this vast swamp area may have been accomplished. Such irrigation is considered likely to be necessary occasionally during long dry periods when the peat soils of the Everglades have become thoroughly dried and subject to fire hazard. Wide difference of opinion exists as to the need for irrigation of crops under drought conditions when the Everglades may have been properly drained. Experience on a commercial scale in agriculture on completely drained areas of the Everglades is too limited to afford conclusive proof. In any event, the culverts are there to provide means of diverting water through the levees for irrigation. Whether the level of the lake may be maintained to allow for floodflow regulation of the tributary streams and for irrigation also remains to be determined.

One of the other principal functions of the culverts will be to deliver water from pumping stations back of the levees through the latter into the lake. With the exceptionally heavy rainfall over the Everglades, coming at times at very high rates, it is necessary to remove vastly more water than may be carried promptly by the four drainage canals that were built primarily for this purpose. When levels of the lake will

permit, this surplus water may be pumped through the culverts into the lake.

Culvert design

The flow line of all culverts is at El. 7, bringing the top of the clear discharge opening to El. 17. The crown of the finished levee is at El. 34 over all culverts, with the exception of two in which it is at El. 36. The standard fill over the culvert barrels thus varies from a maximum of 17 ft. under the levee axis to a minimum of 8 and 10 ft. at the land and lakeside headwalls.

A maximum barrel length of 160 ft. was necessary for the culverts located through the flat 1-on-10 lakewise slope of the hydraulically placed levee sections, while a minimum length of about 90 ft. met the requirements in the 1-on-3 lakeside slope of the dragline-built levee sections. Various lengths of barrel between the above limits were required at other locations, the average length for work completed or under contract being about 110 ft.

Original plans for the drainage culverts contemplated reinforced-concrete box-type structures. An 8x10-ft. rectangular opening was selected as providing the desired discharge area most economically, multiple units being used as required. Single or multiple rigid-frame units, using uniform trapezoidal side walls, 12-in. interior-wall sections and varying thickness of top and floor slabs in accordance with the design loading, were adopted.

Test-boring data indicated that the rigid concrete structures would require the use of foundation piles throughout their entire length at most of the culvert locations. Investigations also showed that multi-plate-type pipe culverts could be used without pile support. The cost of erecting the metal pipe also figured less. When alternate bids on the concrete and the metal pipe culverts were received, those for the metal pipe averaged about 15 per cent less.

The alternate metal pipe design selected substituted a 10-ft. inside diameter for the 8x10-ft. concrete-box section. The pipe affords a clear circular discharge opening of 78.5 sq.ft., compared to an 80-sq.ft. rectangular opening on the concrete boxes.

The pipe-culvert structures, because of their circular shape, were necessarily somewhat wider than the concrete-box type, designed to serve the same location. Barrel lengths in the pipe culverts were in most instances slightly longer or shorter than those of the corresponding concrete boxes, in order to permit fabrication from standard plate sections. These modifications of the concrete-box design to the pipe design, in conjunction with numerous minor dimension changes required in headwalls and aprons, resulted in a net addition of somewhat less than 10 per cent to the estimated foundation excavation, backfill, riprap and paving quantity items required to construct the box culverts.

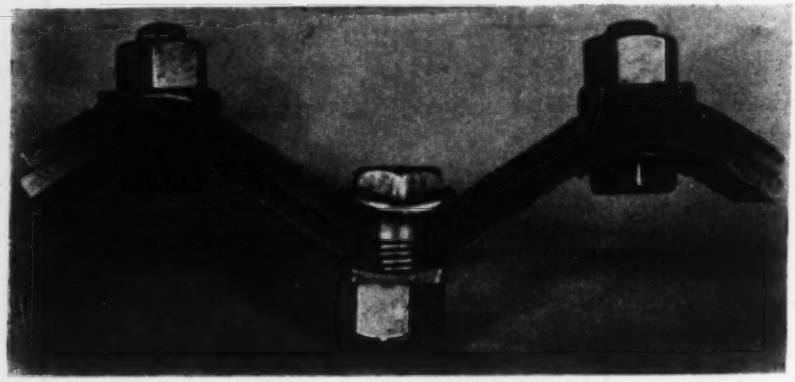


FIG. 2—MULTI-PLATE PIPE JOINT, showing special washers to enable tight bolting of lapped plates.

Headwalls on the two types of culverts are practically the same. Steel gates for both types are quite similar in weight and cost. Any saving that could be secured in the use of the pipe-culvert design was thus confined to the elimination of piling and lower field costs. Cost comparisons in this case, however, require consideration of the peculiar foundation problems, construction conditions and material prices prevailing on the Lake Okeechobee project.

Fig. 1 shows one of the thirteen sets of pipe culverts. Approaches to both ends of the culverts are open-cut channels, extending out to a navigation channel paralleling the levee on the lake side and extending inland varying distances. Floors and slope of these approaches are paved with riprap up to concrete headwalls at the culvert ends. These concrete headwalls and their aprons are founded on timber piles spaced according to the conditions at each site. In all cases these piles take bearing on firm material.

The sectional-plate corrugated-metal pipes are specially designed and protected to meet the difficult conditions of a subtropical swamp with alternate immersion and exposure. The lake end of each pipe is equipped with an automatic, flap-valve, California-type gate.

The flap-valve of the gate is swung on two link hanger bars pivoted on the periphery of the valve and supported by wall bearings anchored to the concrete headwall. The rim face of the valve seats under slight pressure against a seal ring anchored in the headwall, so as to close the pipe completely. Under slight head pressure from the landside, the gate releases from the seat and permits discharge into the lake. The valve seal ring is secured to the concrete headwalls by means of stainless steel anchor-bolts.

To avoid any possibility of an air pocket in the pipe, each is vented above high water through the headwall. In case it is desired to lift the flap-valve up out of the flow through the culvert, this may be done by means of a portable tripod carrying a small chain hoist. Anchorage for the valve in the open position is provided.

Specifications required that the base metal for the corrugated plates must be $\frac{1}{32}$ in. thick before addition of the spelter coating. Pure iron, copper-bearing pure iron, copper iron or copper-molybdenum iron were acceptable as the base metal. No carbon, manganese or silicon beyond irreducible minimums were permissible in the metal. Phosphorous was limited to 0.015 and sulphur to 0.040 in all metals. For copper-bearing pure iron and copper iron 0.20 of copper was specified. This percentage was raised to 0.40 in the copper-molybdenum iron, which also was required to contain at least 0.05 of the latter element. Tolerances were 0.010 on sulphur, 0.02 on copper and molybdenum and none on phosphorous, with the total variation in any event not exceeding 0.04.

Spelter was required to be applied to both sides at a minimum rate of 4 oz. per sq.ft. of double exposed surface. In addition, before field assembly was begun, the sectional plates were all hot-dipped in a bituminous coating. This coating was required to have a minimum thickness of $\frac{1}{16}$ in. It also was subjected to exceptionally stiff tests for spalling, cracking, stability under summer temperatures and imperviousness to 25 per cent acid and alkaline solutions. While these specifications are unusually severe, the conditions under which the culverts will operate were considered to justify them.

Special precautions were observed in the design of the joints between the sectional plates to obtain a rigid tight fit that would stand up under the varying load conditions to which the culverts may be subjected. Details of one of these joints as developed by the Toncan Culvert Manufacturers' Association for this particular installation are shown by Fig. 2.

All bolts, nuts and washers are galvanized. After assembly of the sectional plates into the barrel of the culvert, all bolts, nuts and washers and all abraded places in the surface of the

plates were sprayed with hot bituminous covering.

Assembly of culverts

Conditions surrounding the construction of these culverts were outlined in the general article previously mentioned. Contracts for the installation of the culverts were let to different concerns under an arrangement providing that the contractor would do the excavating, place the concrete and furnish the pipe assembled complete. Of the 2,400.5 ft. of 10-ft. sectional pipe let up to October, 1934, 2,130.5 ft. were fabricated and assembled under subcontracts by the Tri-State Culvert Mfg. Co., Memphis, Tenn., using copper-molybdenum iron sectional plates. The remainder (270 ft.) was similarly supplied by Dixie Metal & Culvert Co., Jacksonville, Fla., using pure iron.

In most cases the excavation for the culverts was done in cofferdams with light power shovels or cranes mounted on crawler treads and operating on timber sectional platforms, to give bearing on the soft muck bottom of the shores of the lake. With few exceptions, there was little difficulty in keeping the coffers dry or in placing concrete.

All bituminous coating was applied on the job. The principal sectional-plate pipe contractor set up a plant for this purpose about midway of the project on the south shore of the lake at Clewiston. Shipments of the sectional plate were made by rail and ocean from the mill to a near-by point and then shunted to the dipping plant by barge.

No important problem was presented in the operation of the temporary dipping plant. Handling was simplified by differential blocks swung from trolleys running on an 8-in. I-beam mounted on a wooden trestle. The maximum weight of a sectional plate was 463 lb., so it was desirable to eliminate handwork as much as practical.

Dipping was done in a semi-portable tank heated by oil burners. After some experimental work, it was found practicable to keep this insulated tank at a temperature of 430 deg. F. No storage for the dipped plates was needed, as dipping was done during favorable weather and the coating dried rapidly.

Transportation of the sections from the dipping plant to the isolated locations of the several culverts was quite a problem. In all cases the culverts had to be built before the levees at their sites were constructed. This meant that the culvert contractors had to do the pioneering in areas where there were no roads close to the site of the work, and often the water was too shallow in the lake to float a barge. Some deliveries were made by motor truck, utilizing such roads as existed and working out to the site as best could be done. Most of the shipments from the plant to the job, however, were by barge along the rim of the lake.

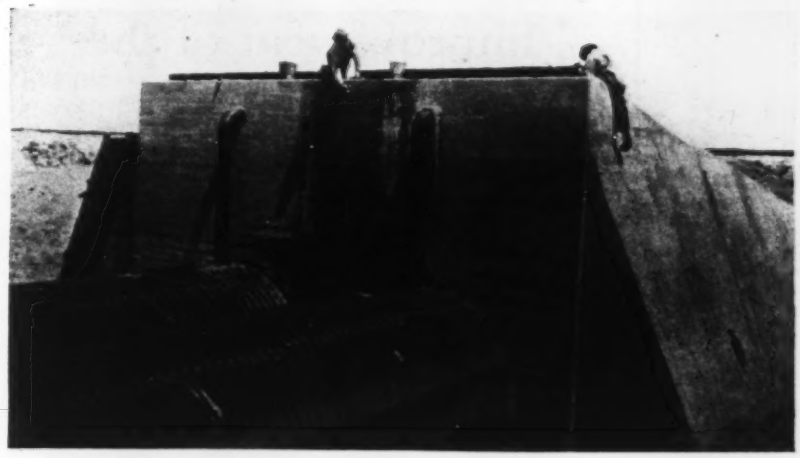


FIG. 3—TWO-PIPE CULVERT, showing vent pipe on each unit passing out through concrete headwall.

FIG. 4—GANTRY for erecting 10-ft. pipes in sections for Lake Okeechobee levee culverts.

Assembly of the sectional plates to form the culvert pipes was rapid and comparatively economical. The sections were shifted from the point where they were unloaded at each job to the edge of the excavation on small cars operating on light track. From these cars they were skidded down into the hole on an incline so set that there was minimum risk of damaging the coating and little hand labor was required on the operation.

Invert sections first were assembled ahead of the side walls. To secure proper alignment, fine grading was done for the invert foundation by hand. Once the invert was in place, the sides were bolted up to the horizontal center line. Then the arch sections were placed. In all cases the sections were set so that a balanced load was on both sides to prevent distortion or movement of the partly erected pipe.

Handling of the sections was simplified by the use of a small portable gantry erected on the job. With this gantry, the sections were easily hoisted into place and held there until the assembly bolts were drawn up tight. The gantry also could readily be moved ahead as the assembly progressed.

Plans for the Lake Okeechobee flood-control works were prepared by the Corps of Engineers, United States Army, and are being executed under the direct supervision of that organization. General Edward M. Markham is Chief of Engineers, and Lt.-Col. B. C. Dunn is engineer of the district, with headquarters at Jacksonville, under which the project is conducted. Lieut. P. A. Feringa is military assistant in that office. Carawan Nelson is engineer in general charge of the project, with Raymond C. Baird, C. C. Schrontz and Perry M. Teeple as associate engineers. Lieut. R. Selee is resident engineer on the project, having associated with him E. W. Digges, assistant engineer, and Lieut. W. H. Mills, of the Corps of Engineers.

George B. Hills, of Hills & Youngberg, consulting engineers for the Lake Okeechobee Flood Control District, has been associated with the project in that capacity since its inception.

Five Years' Improvement of the Elastic-Wire Strain Meter

Continued research on the so-called electric-resistance strain gage has produced an instrument almost entirely of metal in which uncertainties from friction, temperature and corrosion are greatly reduced

By R. W. Carlson
Massachusetts Institute of Technology
Cambridge, Mass.

THE elastic-wire strain meter, first described in *Engineering News-Record,* Oct. 15, 1931, p. 615, and later in the 1932 A.S.T.M. *Proceedings,* has been under continued development since that time, and about 1,500 have been cast in concrete structures for the determination of internal strain. The requirements as to sensitivity, permanence, reliability and ruggedness in a remote reading device to be cast in fresh concrete are not easily met. Consequently the record of this strain meter has not been perfect.

It may be recalled that the early strain meter consisted of two interlapping slabs of porcelain fitted together to permit coils of very fine music wire to be threaded from one slab to the other, so that these coils would undergo change in tension as the slabs were displaced with respect to one another. A change in the relative resistance of the coils provided a measure of the relative displacement or strain. This was a cumbersome, although fragile, meter in which friction, temperature and corrosion played uncertain parts.

The improved strain meter is made almost entirely of metal. The accompanying illustration shows the instrument with the cover removed and the complete meter ready for casting in concrete. The elastic-wire coils are threaded on small porcelain spools that are rigidly secured to steel bars connected one to each end of the meter. One coil is immediately within the other but not touching it. This arrangement insures that the coils be at equal temperature, which is important because a difference in temperature of one-fortieth of a degree introduces a sensible error. The mounting of the coils is such that the tension in the outer coil is decreased as the meter is compressed, while tension in the inner coil is increased. Due to the linear relationship between resistance and tension, the resistance ratio of the two coils is changed in direct proportion to the change in gage length. The coils are connected to a portable testing set, forming a Wheatstone bridge circuit. Direct readings are made of the ratio of resistances of the two coils. The ratio is not affected by temperature change even though the resistances themselves are affected.

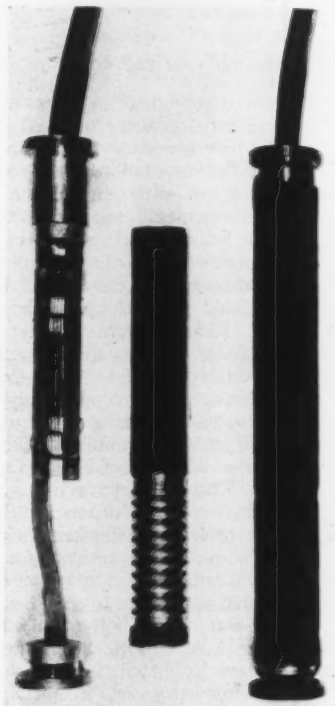
Strain cannot be determined from a single measurement, but the strain that develops over an interval of time may be determined by comparing the resistance ratios at the beginning and end of the period. The change in ratio is simply multiplied by a constant to give "indicated" strain. In the standard meter of 10-in. gage length, the constant is about 400 millionths of an inch per inch for each 1 per cent change in ratio. Since ratios are usually measured to 0.01 per cent, four-millionths is thus the least reading. Individual calibration is required for accuracy and for determining the useful range of each meter.

The indicated strain represents the actual deformation if there is no temperature change, but otherwise it must be corrected for thermal expansion or contraction of the meter frame to obtain actual deformation. When the meter is cast in concrete, which expands freely due to temperature rise, the meter will generally indicate a slight contraction because its frame expands more than does the concrete. For the standard meter, 7.5 millionths must be added to the indicated strain for each 1 deg. F. rise in temperature, to obtain actual deformation.

Temperature can be determined to about 0.5 deg. F. from the combined resistance of the two coils of the strain meter. This is possible because the increase in resistance of one coil due to strain is offset by an almost equal decrease in the other.

The testing set for the strain meter is a portable Wheatstone bridge, which is highly accurate yet simple. Actual resistances can be measured to 0.01 ohm, and lead-wire resistance can be eliminated automatically if an extra lead wire is available. For ratio measurement there are two ranges and corresponding sensitivities. If the strain-meter coils have nearly equal resistance, so that the ratio is between 0.98 and 1.02, readings to 0.005 per cent can easily be taken. For ratios between 0.95 and 1.05, the least reading is 0.01 per cent. No contacts enter into the circuit for measuring resistance ratios.

The first and most serious trouble encountered in developing the strain meter was that of corrosion of the elastic-wire coils. Notwithstanding the protection offered by oil around the coils, their resistance was increased by corrosion, probably due to sulphur contamination of the oil by the original rubber cover. The design was changed by stages, leading finally to the double-celled metal instrument that is the present strain meter. In the final instrument the lead wires terminate in one cell called the sealing chamber, and the elastic-wire coils are housed in the other, which contains no rubber or other contaminating material.



STRAIN GAGE whose functioning is based on the direct relationship between electrical resistance and tension in a wire. From left to right are shown the instrument, the cover and the complete assembly ready to be embedded in concrete.

All resistance to deformation is now elastic. The metal cover yields elastically in its corrugated section; the coils are necessarily elastic; and the two steel bars are linked together by highly elastic flat springs of steel. The elasticity permits smooth calibration lines to be obtained and makes the meter responsive to minute strains. The strain due to a man's weight on a 6x12-in. concrete cylinder has been detected.

As a result of two years of experimentation, castor oil has been adopted for filling strain meters. The oil does not entirely fill the case, and the remaining space is filled with nitrogen to allow for volume change. The meter is sealed when the oil is warm, to reduce internal pressure variations.

The force to deform a strain meter is chosen so as to compromise between maximum ruggedness and response under adverse conditions. For the standard meter, a force of 1 lb. causes a deformation of about 0.0005 in. This meter is fairly rugged and does not give a true measure of deformation in concrete during the first half

day or more after casting. More flexible meters are made when early deformations are to be measured, and these must be handled with extreme care.

Applications of the strain meter

The strain meter is most useful for measuring strain at inaccessible points, such as the interior of a concrete member. Most of the strain meters used thus far have been cast in dams, with a fair percentage in laboratory specimens. Recently a miniature meter has been developed for the measurement of internal strain in models of massive structures.

Thus far no thorough study has been made on any field installations of the improved strain meters in dams. Periodic readings are being taken, and in general, the curves of strain plotted against time parallel the temperature curves. Meters placed in a vertical direction show the effect of increasing weight of a dam under construction about as expected. Shrinkage due to drying has not been detected in the interior of a large dam. Thermal deformations and stresses are found to be important, and plastic yielding, especially during the first few days when temperature is rising, is found to be closely related to later cracking.

A temporarily disconcerting result was observed on a highway installation in California. Strain meters were cast in a vertical direction in an attempt to determine the free shrinkage of the concrete, since in other directions an indeterminate subgrade restraint was present. The highway cracked, first due to temperature drop after becoming rigid at an elevated temperature, and later the cracking continued due to drying effects. The meters did not indicate any shrinkage due to drying, and it was concluded that the instruments were faulty. Later research demonstrated that concrete does not shrink uniformly in all directions upon drying and may not shrink at all in the direction of moisture travel. Since in the highway the meters were in the direction of moisture travel, the unexpected behavior was thus explained.

Special elastic-wire meters of long range, called "joint meters," are being used for measuring the opening of contraction joints. Whereas the strain meter has a range of about 0.02 in., the joint meter has a range as great as 0.25 in., obtained by connecting strands of the elastic wire in series with small coil springs. The design is such that a certain amount of shearing movement on the joint will not materially affect the meter or its accuracy.

Since the accumulative deformation of a whole block of concrete is absorbed at the joints, the joint measurement serves to supplement and to check the data obtained from the strain meters. It is expected that detailed results of some field investigations will be published shortly.

Austrian Fatigue Tests of Reinforced Concrete Beams

TESTS recently conducted by Dr. Eng. Rudolf Saliger, professor of reinforced-concrete construction and statics, Technical University of Vienna, concern the influence on reinforced-concrete beams of repeated load applications. The report has not yet been published, but the following brief statement of the conclusions drawn by Dr. Saliger, which is based upon a translation from the original German, indicates the nature of the investigation.

The beams tested were reinforced with four kinds of steel, ranging in ultimate strengths from 121,000 to 62,000 lb. per sq.in. and in size from approximately 1-in. round to ½-in. round. A new type of reinforcing steel, which has been used in Europe to some extent, called "Isteg" steel, was also included. The Isteg steel had an ultimate strength of 64,000 lb. per sq.in. and a yield point of about 81 per cent of the ultimate, or 52,000 lb. per sq.in. The high yield point is attributed to the method of manufacture, which consists of twisting together two ordinary mild steel bars while cold. The yield points of the other three steels ranged from 52½ to 65½ per cent.

The concrete used in all specimens was the same—a 1:4.75 mix with a water-cement ratio of 1.04 to 1.08. The crushing strength of the concrete ranged from 4,600 to 4,800 lb. per sq.in. at an age of 400 to 500 days. The modulus of rupture was of the order of 780 lb. per sq.in.

In the fatigue tests the specimens were subjected to 1,000,000 to 3,000,000 load repetitions at the rate of 160 to 170 a minute. In some cases the load was applied in four to seven increments up to a maximum of 34,200 lb. per sq.in. tension in the steel. When the load was applied without graduation, the maximum load gave a steel stress of 28,400 lb. per sq.in. It should be noted that the maximum stresses were about 55 per cent of the ultimate and 10 to 30 per cent higher than normally allowed in building practice.

The first cracks in the test beams recorded by the extensometers, long before they were visible, occurred at a steel stress between 5,700 and 11,400 lb. per sq.in. During the fatigue tests the cracks opened and closed. As in static-load tests, the number of cracks was larger, but the cracks were narrower the smaller the diameter of the bars. For the same load capacity the higher-grade steels were better than the lower grades, providing the smaller sizes were used in accordance with their tensile strength.

Elastic recovery was observed in all fatigue tests, as shown by the reduction in deformation during the rest period. Deformation and deflection during the application of the fatigue loads showed a tendency to attain a state of permanency. The concrete became fully resilient as a result of the repeated load applications. Another particularly interesting observation was that the total and permanent deformations shown during the static deflection test in the range of working stresses were smaller for beams given a preliminary fatigue test than for beams not first subjected to repeated load applications. At the maximum loadings the deflections were the same regardless of whether the specimens were first subjected to a preliminary fatigue test.

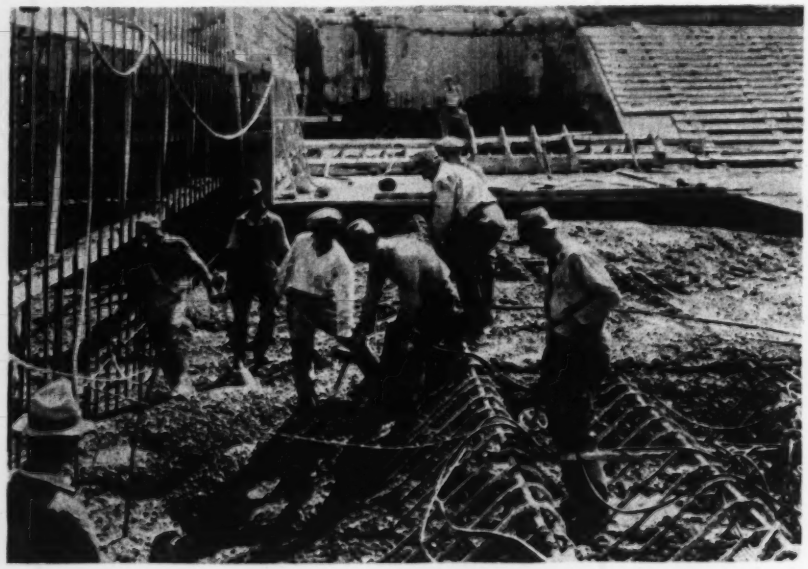
It was noted that the Isteg reinforced beams showed less marked breaks in the deformation curve. The elasticity of such beams was higher than those reinforced with ordinary bars. Under otherwise identical conditions and within the permissible stresses the quality of the steel had no effect on the deformation.

The carrying capacity of the beams was not reduced by several million load changes (the applied load being limited to 55 per cent of the breaking load). Also, there was no reduction in bond or shear resistance nor in the compressive or tensile strength of the component materials.

As is customary, the exact yield point of the steel was noted in the performance of the beams reinforced with ordinary steel. Those reinforced with Isteg steel and a low percentage of ordinary steel were exceptions to the rule. In the case of the Isteg steel, there is no exact yield point, but a theoretical value is taken at 0.4 per cent elongation, the stress naturally increasing with increasing elongation. The measured elongations during the test corresponded to steel stresses considerably higher than the ordinary yield-point stress. Dr. Saliger calls attention to this as an advantage of Isteg steel over ordinary reinforcement. Furthermore, because the reinforcement has no exact yield point, the concrete compression during failure builds up more slowly in Isteg reinforced beams. Dr. Saliger states that under ordinary working loads it would, therefore, be possible to increase concrete stresses 15 to 20 per cent as compared with beams reinforced with steels having a high elongation. Isteg reinforced beams also showed greater resilience, indicating a greater impact-resistance.

High Speed in Concreting at Norris Dam

Skillful mechanization in detail devices and in general plant arrangement is setting records which exceed by a third the yardages estimated to be practicable



SMALL-AGGREGATE CONCRETE around steel is settled into close bond and dense solidity by internal vibration in concreting the Norris Dam of the TVA.

RECENT RECORDS in placing concrete in the 1,000,000-yd. Norris Dam of the Tennessee Valley Authority on the Clinch River in east Tennessee reflect the combination of a modernly equipped undertaking of this magnitude handled by specially selected crews of labor under thoroughly experienced supervision. Original plans contemplated that from 50,000 to 60,000 cu.yd. would be placed per month, with a probable maximum of 75,000 cu.yd. So closely has the concrete mixing and handling plant (*ENR*, Dec. 6, 1934) been synchronized, however, that 83,634 cu.yd. were poured during last January, and in 24 working days of 23 hours each in February 84,413 cu.yd. were placed. This record was raised to 86,962 cu.yd. in March, during which month one mixer was out of commission for a time for repairs.

For these three months the average rate was 3,493 cu.yd. per 23-hour day, with a maximum output of 4,160 cu.yd. in one day. The latter figure means that 180 cu.yd. were mixed and placed every hour with three 3-yd. mixers in the plant and two 1,900-ft.-span cableways, each handling a 6-yd. bucket.

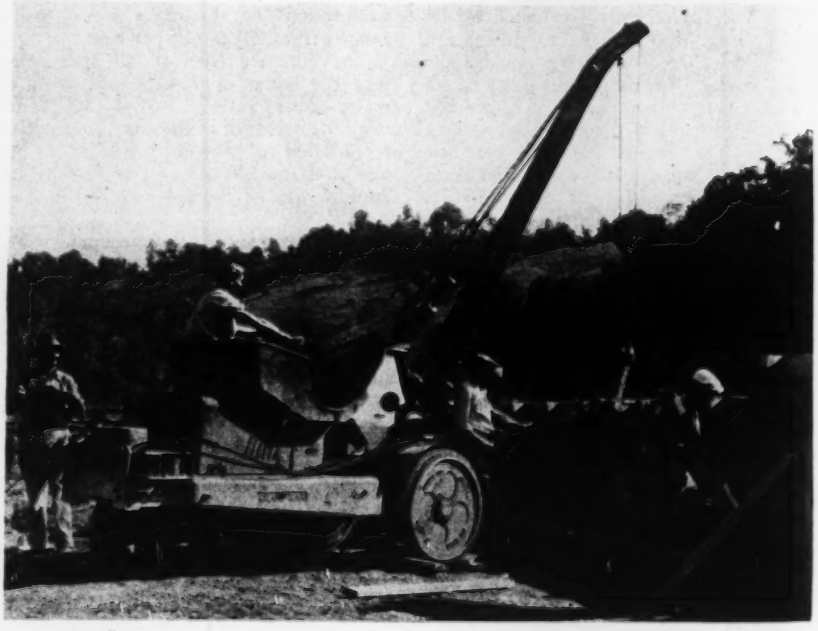
These records were made before the dam sections being poured had reached a height where they taper down much. While the original expectations were that only one cableway might be employed in the narrow sections toward the top of the dam, it has been found that the two cableways can deliver concrete to the same spot with practically no loss of time in shifting the head-towers sideways when the buckets are traveling between the loading and the discharge points. This facility in changing the position of the cableways quickly was made possible by the use of movable cableway towers of the thrust-wheel type.

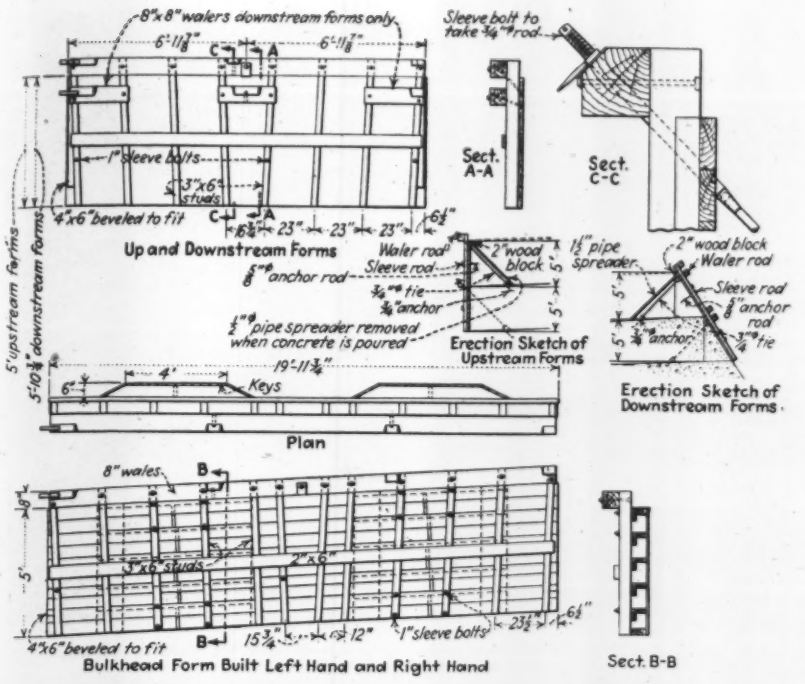
Although the maximum sustained rate of placement of 180 cu.yd. per hour occurred when the two cableways were delivering concrete to two different points, with no shifting of the towers necessary, a rate of 175 cu.yd. per hour is maintained when both cableways deliver concrete to the same spot. This means that both cableways may be used simultaneously to the end of the job. As a result, it is estimated that three months will be saved in the concrete placement.

Sequence of operations

Plans for placing concrete for Norris Dam provide for carrying the Clinch River through the project. Provision was made to handle a maximum flow of 40,000 sec.-ft. across the site during progress of the job. With the cableway system of handling, it was possible to prepare the foundation and pour concrete in the stream channel within comparatively low-cost cofferdams. In the early stages topping of the cofferdams might have involved limited damage, since the few units of portable equipment in the latter could promptly be removed. Pumping out after the river dropped again and some cleaning up of silt would be the only expense. As a

MOBILE CRANE riding on hardened concrete inside the forms strips the form panels and raises them into position for concreting a new lift.





MOVABLE FORM PANELS used in concreting Norris Dam. Four panels constitute a form for a 56-ft.-long, full-dam-thick section of the spillway structure.

matter of fact, with one brief exception before much of a start had been made, no difficulties have been experienced from high water. During the latter part of March and early April flows of more than 40,000 sec.-ft. were experienced, with two peaks of close to 50,000 sec.-ft. and no resulting damage.

As a general policy, the dam is carried up in alternate sections, 56 ft. wide with the long axis of the dam and to the full contour of the two faces of the latter. Two 20-ft. steel penstocks extending through the dam are each in adjoining sections. These two penstock sections were not for a time carried up in sequence with the rest of the dam, since some changes in design of the gates controlling them were adopted that made a delay on these sections necessary. Otherwise, the alternate-section plan has been followed from the beginning, concrete being poured in 5-ft. lifts.

After a lift is poured in a section, it is permitted to set a minimum of 72 hours before the next lift is placed on it. This combination of alternate-section and staggered-lift pouring provides time for the heat generated in the setting of the concrete to be dissipated satisfactorily.

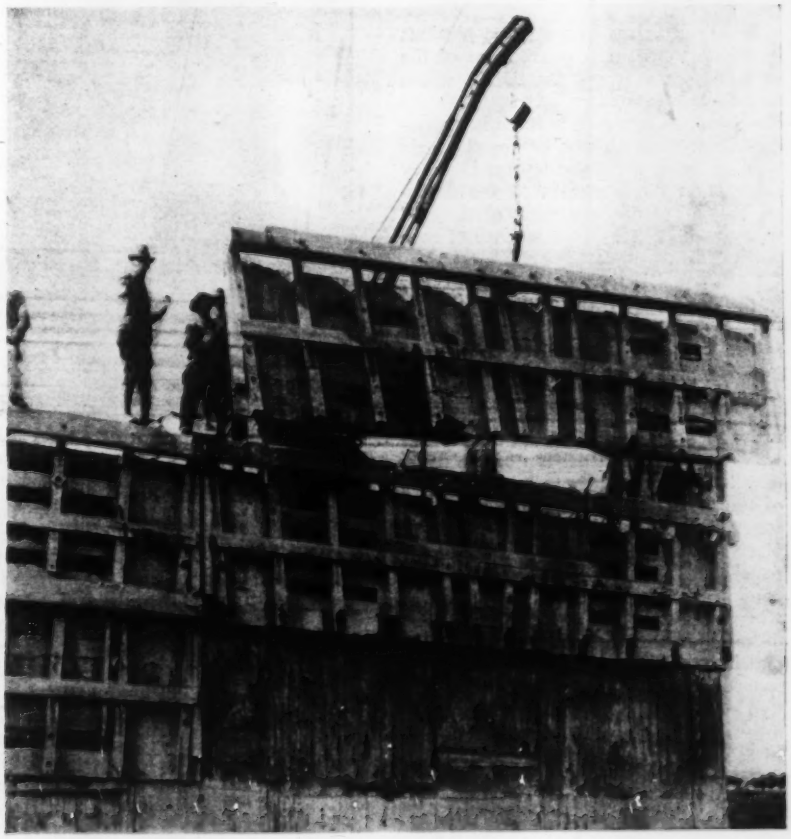
Form construction and handling

Before pouring of concrete was begun, the decision was made to eliminate the vertical steps commonly used on the surface of each lift. To obtain the keying provided by such steps, the surface of each lift is laid on a 5 per cent descending grade from the downstream to the upstream faces of the section of the dam. By finishing this slightly graded surface fairly smooth the use of wheeled portable equipment on the hardened concrete of each lift is practicable.

This plan of procedure in pouring the lifts permitted the adoption of a

LIFTING HOOK for form-handling crane is so designed that first strain pulls the panel outward and strips it from the concrete before hoisting begins.

FORM PANEL being hoisted by crane and erected ready for pouring another lift of Norris Dam.



simplified system of standardized panel forms in sections that could be shifted by a portable crane operating on the surface of each lift. This scheme of operations eliminated need for any reliance on the cableways to handle forms, except occasional shifting of the crane, and now and then of sections of the forms. As a general thing, the forms for each section are carried up with it.

Details of the upstream and downstream face forms for the sections in which the dam is poured are shown in an accompanying drawing. All panels are 13 ft. 11¾ in. long. The upstream panels are faced with dressed 2-in. plank to a height of 5 ft., and those for the downstream face to a height of 5 ft. 10¾ in. The eight 3x6-in. studs to which the plank facing is spiked are battered on both sides of the vertical center line of the panel, as shown in the drawing, to prevent lateral movement of the panel by engaging the studs of the panel below, which already is anchored to the hardened concrete of the previous lift. Beveled 4x6-in. studs on both ends of the panel provide straight ends to fit properly with the abutting panels.

Anchored to the projecting top ends of the studs is an 8x6-in. waler that serves several purposes. This waler stiffens the ends of the studs and provides a means of anchoring the panel to the previously poured concrete of the lift below. It also engages the bottom ends of the studs on the panel set on it above, so when the panels are in place this waler is common to two.

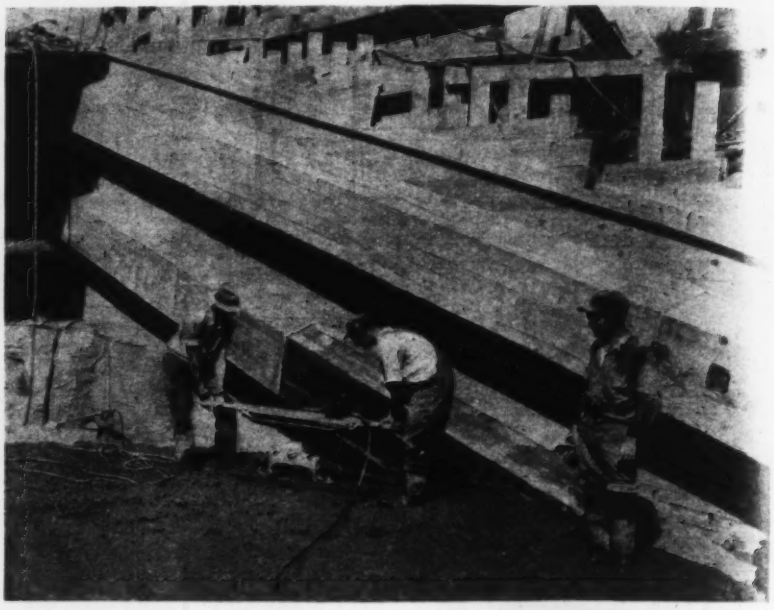
Bulkhead forms between the sections in which the dam is poured are of the same design as those for the upstream and downstream faces, except that each panel carries two 4-ft. vertical key spacings 6 in. deep. These bulkhead panels also are made right and lefthand. They slope from the upstream to the downstream end of the section, to correspond with the slope left on the surface of each pouring lift.

Each panel is tied to ¾-in. anchors set in the previously poured lift below it by four ¾-in. rods. The top end of each rod is threaded inside the form to engage a short section of internally threaded rod extending through the 8x8-in. waler of the panel. This piece of waler rod carries a wing nut and an OG washer with which the top of the panel may be drawn exactly to line. The top of the panel then is held in position by four 1½-in. pipe spreaders wedged in place at the top against the face of the panel and against the concrete at the bottom. These spreaders are removed when the lift is half poured. As an additional anchorage for the bottom of the panel, a row of four 1-in. sleeve rods is spaced horizontally 2 ft. from the bottom of the panel, to hold the latter by means of ⅞-in. anchor rods embedded in the concrete.

Each panel carries a 1-in. eyebolt set midway between the ends in the 8x8-in. waler. A specially designed hook on the fall line of the portable crane engages this eyebolt in handling the panel. This hook is made so that it fulcrums against the form of the lift above in such manner as to tip the top of the panel slightly out from the face of the finished concrete as the crane hoists the load. No hand prying or pulling is required.

With this design of panel, the only handwork necessary outside the forms in shifting the panels is the removal of the waler rods on the ends of the ties and the row of 1-in. sleeve rods. This is done by men in linemen's slings. Before the men are lowered over the side the crane hooks on the eyebolt. As soon as the waler rods are loose and the outside men are clear, the crane strips the panel from the concrete and hoists it to a position directly above the one already anchored over it. The shifting is rapidly and easily done with a minimum of labor. The panels fit truly and firmly with no adjustments or jacking necessary. Panel alignment is readily attained and without exception is accurately maintained.

Three-point support was provided for the portable crane with which the panels



PLATEN-TYPE VIBRATOR smooths off surface of each lift when it has been concreted to full prescribed height of 5 ft.

INTERNAL VIBRATORS perform the real task of settling and compacting the dry coarse concrete mixture.

are shifted, in order to insure stability on the rough concrete. Two of these cranes handle all of the panels on the entire job. They are quickly shifted from section to section by either of the cableways. The latter simply hook on to a wire-rope sling kept fastened to the frame of the crane and hoist and move the latter to the next section on which it is to work.

With more than half the 1,000,000 yd. poured, this type of form has proved to be entirely satisfactory. Except for rare damage to the facing plank from accidents in handling, no repairs have been necessary. Indications are that the limited number of panels required may be used to the end of the job.

Concrete placing

The pouring of each 5-ft. lift is started at the upstream end of the section. The surface is built up to maintain about the 5 per cent slope on which the lift is finished. With the dry mix used and the large proportion of cobbles in the mix, special care is taken to obtain thorough compaction of each bucket load and complete blending with the loads previously placed with which the new load comes in contact.

Immersion-type vibrators are used to consolidate all concrete. On the average, about 1½ min. is required to compact a 6-cu.yd. batch of the relatively dry concrete used in the body of the dam, enough to bring water to the surface so that there is the appearance of having used a rather wet mix. The surface of each lift is smoothed off with a flat platen-type vibrator.

Power for the vibrators is supplied by a separate motor-generator set with which it is possible to obtain a change in frequency. Experience has shown that 80-cycle current is more effective than 60-cycle for this service.

At the present rate of progress it is estimated that Norris Dam proper will be completed before the end of December of this year. Storage of water will be possible some time before that. Since the flush flows of the Clinch normally occur between November and May, the full value of Norris Dam in supplementing the usual low summer and fall flows at the main dams on the Tennessee River is expected to be available in 1936.

A. E. Morgan is chairman and chief engineer of the Tennessee Valley Authority. C. A. Bock is assistant chief engineer, C. H. Locher is construction consultant, and A. J. Ackerman construction plant engineer. Barton Jones is engineer of construction, and Ross White superintendent of construction on Norris Dam.

320-Ft. Timber Radio Tower a Self-Supporting Structure

First three-sided tower, in Richmond, Va., attains a total height of 320 ft. and is framed with split ring connectors

By Frank P. Cartwright
Engineer, National Lumber Manufacturers Association, Washington, D. C.

THE NEW 320-ft. all-wood radio broadcasting tower recently completed for Station WRVA at Richmond, Va., and formally dedicated on April 21, is believed to be the highest self-supporting wood structure built in this country up to date, although several higher wood towers supported against lateral wind pressure by guying have been erected. The Richmond tower also is unique in the use of a triangular plan for wood construction. The desirability of suspending a broadcasting antenna from a structure entirely of insulating material has long been recognized, and wood towers for the purpose have been in use in various European countries for a number of years. Their introduction to American practice, however, was made possible by the commercial availability of timber connectors of the metal ring or disk type in this country.

In working out the design for this first tower, reference was made to European plans for similar structures and to various projects already completed in this country using connectors. The methods employed both for fabrication and erection were similar to those used in steel structures, although some experimentation was required, to arrive at the best erection methods. The erection was carried on at a time when rain, wind and cold admitted of only 33 working days in three months, and completion of the work was much delayed.

High-grade lumber used

Since the loads due to wind pressure are a principal factor in the design, it is desirable in such structures to use a high grade of timber. The higher working stresses allowable with selected material result in smaller sections and reduced wind loads, and consequently bring further reduction in required sections. The lumber used was 100 per cent heartwood, dense longleaf yellow pine, with the slope of the grain limited to 1 in 15, and knots and pitch pockets to less than 25 per cent of the cross-section of the piece. Shakes and wane were not permitted.

The lumber was surfaced four sides to American Standard sizes, to facilitate the careful fitting required at some points, and all material less than 4 in. thick was kiln-dried before shipment. Maximum lengths used were 24 ft.

Design considerations

Wind pressure for design was assumed at 30 lb. per sq.ft. on the face area of the tower, corresponding to an assumed wind velocity of 100 miles per hour, with additional allowance for a velocity of 70 miles per hour acting on the leeward faces of the structure. The weight of the timber used was assumed at 42 lb. per cu.ft. The proportion of wind loads to those caused by weight of the structure in leg sections near the base is about 5 to 1. In consideration of this, and since a maximum wind and sleet load simultaneously were regarded

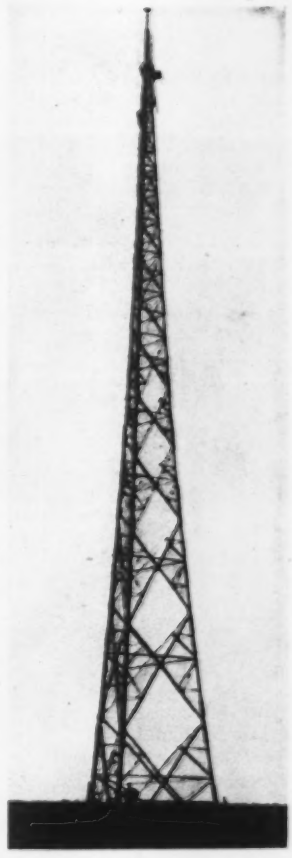


FIG. 1—Installing a mast to bring total height of radio tower to 320 ft.

as extremely improbable, no allowance was made for sleet.

According to customary practice in designing timber structures for short-time loads such as result from wind gusts, the usual working stresses for long-time loads were increased 50 per cent, resulting in a maximum short column compression stress of 2,100 lb. per sq.in., reduced according to the usual column formulas, and a maximum allowable tension stress of 2,400 lb. per sq.in. Working loads for 2½-in. and 4-in. split ring connectors were 6,000 and 11,500 lb. respectively, per pair, acting parallel to grain, reducing in straight-line ratio to 4,500 and 7,500 lb. at 90 deg. to the grain. Base-plate connections were made with shear plates, another type of connector adapted to transmit loads between wood and steel.

The structural features of the design are clearly shown in the illustrations herewith. The same system of web members is employed as in previously built European towers. The WRVA tower is unique, however, in that three independent and identical faces were employed, connected at the corners of the tower by hexagonal spacer pieces to which they are respectively attached with split-ring connectors. Besides affording mutual lateral support at frequent intervals to the leg pieces, acting as columns, these spacer pieces act also as splice plates. They are discontinued at panel points, and the space between the legs at these points enables the face members, which are practically all double, to be attached at the same levels for all faces. The identical character of the three faces considerably reduces the variety of pieces to be fabricated, and the provision of horizontal members in adjacent faces at the same levels facilitates the placing of staging plank for erection.

The tower corners converge at the top to single members, which in turn support a turned mast, projecting 40 ft. above the framed structure.

The base width of the tower is 38½ ft. c. to c. of piers and the three faces rise to a height of 280 ft., from which elevation a mast extends 40 ft. higher. The sides of the faces are curved according to a parabolic formula, to secure uniform loads in face members and most efficient use of the structural characteristics of the material. Splices in adjacent leg members are offset about one half the lengths of the pieces. Patents have been applied for on the unique features of the construction.

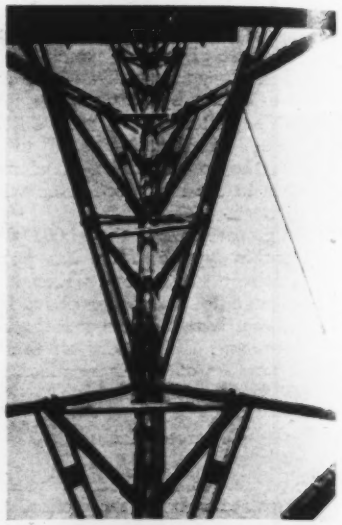


FIG. 3—CORNER CONSTRUCTION in which spacer members are utilized to splice leg members of faces. Spacers are discontinued at panel points where web members intersect legs.

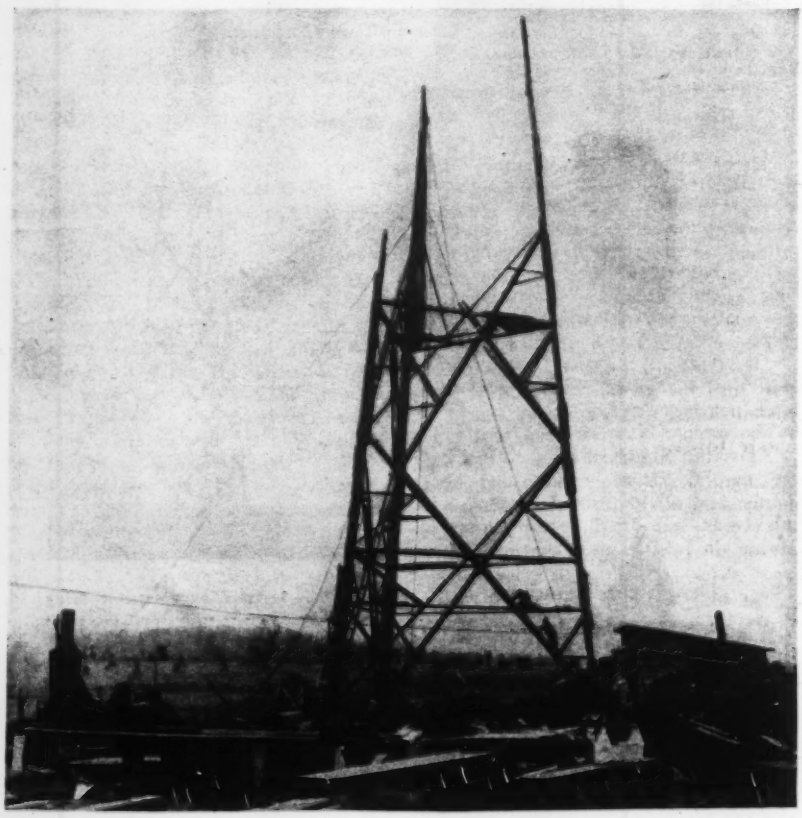
Fabrication and erection

It is the usual practice to shop-fabricate members for ring-connected structures in the same fashion as steel, and shop details were prepared for all members of the Richmond tower. In view, however, of the experimental character of the WRVA installation and the fact that the material would not be treated, fabrication was carried out on the ground. All pieces were laid out with steel tape and square, and holes were bored with a light drill press. Grooves for split rings were cut with a portable drill, employing special tools furnished by the ring manufacturer.

Erection was carried on by steel workers, and it was found that with a little experience they were able to handle the unfamiliar materials and connection methods as readily as a routine steel erection. The lower parts of the tower were placed with a gin pole, resting on convenient horizontal members. A traveler, attached to the outer leg faces at one corner, was used for the upper panels. The mast, 60 ft. in length over all, was hoisted up through the center of the tower until connectors already installed in the inside faces of corner pieces engaged grooves cut in the mast.

The tower was built for Larus and Brother Co., tobacco manufacturers, of Richmond, and owners of WRVA, of which C. T. Lucy is manager, on recommendation of Paul Godley, radio consultant, Upper Montclair, N. J. It will be equipped with a special type of antenna developed by Mr. Godley to take advantage of the complete insulating characteristics afforded by the wood tower. The tower was designed by the writer and checked by Peter Landsem, engineer of the National Lumber Manufacturers Association, Washington, D. C. Fabrication and erection were done by the Wise Granite & Construction Co., of Richmond, Va., under the personal supervision of its president, Lee Paschall. Connectors were furnished by the Timber Engineering Co., a subsidiary of the above association.

FIG. 2—FABRICATION and erection operations under way on three-sided timber radio tower for Station WRVA, Richmond, Va.



Engineers Play Active Part in CCC Work in Indiana

Eighty civil engineers employed in carrying out a program of improving and conserving the natural parks of the state—Work covers forest trails, water supply, sanitation facilities, park shelters and soil-erosion structures

By Denzil Doggett
Assistant State Engineer, Indiana Department of Public Works, Indianapolis, Ind.

FIG. 1—STONE-ARCH BRIDGE across the arm of a proposed lake at Spring Mill State Park, Mitchell, Ind., built by the CCC. The normal flow line will be at spring line of the arches. The stone fill at either end of the bridge will carry a park drive from the entrance to the restored Spring Mill village.

STATE PARKS, forest preserves, game preserves and other lands owned by the state of Indiana and administered by the State Conservation Department have been greatly improved during the past year or so by the work of the Civilian Conservation Corps. Forests have been cultivated, trails have been built, water-supply and sanitation facilities have been constructed, and many other operations designed to improve and conserve the state's natural resources have been undertaken. Forty-three hundred men have been engaged in this work, comprising twenty CCC companies and located in seventeen camps.

The services of eighty civil engineers have been utilized in the planning and supervision of the engineering and construction phase of the program. Of this number, eleven have been engaged in headquarters planning, twenty in state forest and game preserves, twenty in soil-erosion work, and twenty-seven in state parks.

In Indiana, CCC work on state-owned properties has been administered through two federal agencies: the Forest Service of the Dept. of Agriculture, and the National Park Service, of the Dept. of the Interior. The division of forestry of the State Conservation Department cooperates with the former federal agency and the division of state parks and lands and waters with the latter. Work in game preserves and fish hatcheries is taken care of also through the division of forestry, work plans being initiated by the director of the division of fish and game.

State forests and game preserves

A total of 38,675 acres comprises Indiana's present forestry and game preserve holdings. These are in units ranging in size from 4,795 to 12,115 acres. Nine CCC camps are located on or near these holdings, and 2,300 workers are engaged. Twenty civil engineers are employed in the various phases of engineering and construction work noted in the following paragraphs.

The work of the CCC on state-owned forest lands and game preserves is primarily forest improvement, such as thinning out mature and weed-species trees, operation of forest tree nurseries, preparing fire lanes, building fire-truck trails, and the planting of trees. Secondary work is minor construction, calling for varying degrees of civil engineering experience in the design and execution of each job. Some of this work is the preparation of plans and supervision of construction of truck trails, state forest administration and service buildings, design and supervision of construction of water-supply systems and sanitation plants for the service area, fire-tower layout and construction, design and construction of dams for impounding water supplies and flood-protection purposes, nursery irrigation plant design and construction, forest boundary surveys and marking, mapping, etc.

The camp supervisory personnel consists in the main of foresters. The camp superintendent, however, is either a forester or civil engineer. He generally has an assistant superintendent who is chief engineer of the camp. There are from one to three assistant engineers, depending upon the size and importance of the state forest and its state of development previous to the advent of the CCC camps.

In all work involving engineering construction, engineers are assigned to make the necessary surveys and to draft plans for the construction foremen. Also, the engineering staff retains general supervision of the construction work. All such plans are checked and revised in the offices of the Conservation Department's division of engineering before being executed.

In connection with earth dams for water supply or flood control, great care is exercised in design to fit each into its location. Spillways are usually of the drop-inlet type because of the great saving in construction materials over the open gravity spillway. Each dam is designed to use a minimum of materials and a maximum of labor. However, no construction is a "make-work" project—each is some structure which would be built some years later, if and when funds become available.

In the surveys and plans for the truck trails for fire-protection purposes, special attention is given to the alignment and grades of those that will later become main forest drives for displaying special tree plantations or a choice stand of timber. This careful engineering is done so that when it becomes desirable to open a road to public use, all that will be necessary will be the lengthening of cross-drains and the widening of the grade and surfacing material. This prevents a repetition of effort later in widening curves and making realignments, necessary for heavier public traffic.

Water supplies of sufficient quantity for camp purposes and for public use and of satisfactory quality were difficult to develop. The principal sources found to be adequate that can be treated to produce potable water have

been infiltration galleries and impounded streams. Wells and springs are used to a smaller extent. Water obtained from infiltration galleries requires only chlorination to make it usable. It is somewhat turbid during rainy seasons, but not objectionably so. With impounded supplies, aeration, pressure filtration and chlorination have been found necessary. Spring supplies and practically all well supplies are chlorinated to make them safe for use.

FIG. 2—SPRINKLING SYSTEM installed at the Nancy Hanks Lincoln Memorial, Lincoln City, Ind. The grave of Lincoln's mother is located just back of the tree line in the edge of the timber.

In the construction of forest administration building groups, nursery packing sheds, fireplace-type shelter buildings for picnic and camp grounds, timber lookout towers and other forest buildings, native sawed lumber from selective thinning of timber stands is used. Buildings are of rugged construction and designed to withstand many years of hard use.

A number of standard metal observation towers for the protection of privately owned woodlands against fire are being constructed on small state-owned tracts of land. These towers are located and constructed under the supervision of an engineer from the nearest CCC camp.

A boundary survey of each state-owned forest is being made to assist in the location of a protective fire lane, so that no clearing of timber and bushes shall be done on privately owned land.

Engineering in two game preserves consists of the design and supervision of truck trails for fire protection, administration buildings, impounding reservoirs, vermin houses for wild game display, pheasant hatcheries, game pens, fish hatcheries and rearing ponds, water-supply systems, sewage-disposal plants, shelter houses with fireplaces and ovens for picnickers, and oven shelters in service areas.

An additional pond area is being added to one fish hatchery so that its capacity will be doubled. This work includes levee and pond construction, water-supply lines, pumping plant, drainage lines and concrete collectors. The latter are used for gathering the fingerlings, prior to planting in adjacent streams and lakes.

Erosion control

Another CCC activity under the direction of the division of forestry is that of erosion control. Eight CCC camps are devoted to this purpose with an agricultural engineer, C. D. Kinsman, in charge of the engineering features. Nineteen civil and agricultural engineers are employed in this work. Two engineers are attached to each camp. Seventeen hundred CCC workers are engaged in this type of work.

Work in state parks

Indiana's state parks and memorials contain 13,342 acres. A total of 2,000 CCC workers are engaged in improving these parks, and 27 civil engineers are employed in the engineering and construction work described in the following paragraphs.

The work of the civil engineer in the eight CCC camps located in state parks is varied. It consists in the main of the designing of roads, bridges, buildings, structures of all types, water-supply systems and sewage-disposal plants, staking out the tasks for the workers, supervising construction, making boundary and land surveys and topographic mapping.

The organization of each camp is more uniform in regard to engineers than in the case of the forest camps, as the needs of each park for the services of the civil engineer do not vary greatly. Practically all of the eight camps have three to five engineers assigned to the supervisory personnel of each. In addition, the superintendent of each camp is either a civil engineer, a landscape architect or a recognized construction executive or contractor. This makes for efficiency in all the engineering phases of the camp's work. Landscape architects, architects and practical construction men complete the supervisory personnel.

All engineering plans for work in state parks are submitted to the division of engineering for checking and revision. If they are found satisfactory in all respects, they are approved by the assistant state engineer and by the director of the division of state parks and lands and waters. They are then forwarded to the district office of the National Park Service for further check and approval or disapproval.

FIG. 3—TIMBER TRESTLE, 180 ft. long, which carries the entrance drive at Clifty Falls State Park. This trestle is 85 ft. high and carries a concrete roadway 22 ft. wide. It is on a 5 per cent grade.

One of the most important phases of CCC work in the eight parks affected is the development of an adequate supply of potable water for public use for the camp grounds, picnic grounds, beaches and hotels. In some cases this means the addition of wells and the installation of larger and more efficient pumping plants and distribution systems. In one instance, it means the careful utilization of the output of a well. To accomplish this, a concrete storage reservoir with sufficient capacity to handle a two-day peak supply for the park, in addition to the daily replenishment of a 240,000-gal. swimming pool, must be constructed. In another park it was impossible to secure water in sufficient quantities from wells of any type. In this case, an impounding reservoir of 43-m.g. capacity has been constructed. Aeration, filtration and chlorination then furnish a supply of potable water for public use in the park. Another water supply was enlarged by the collection of water from a number of springs to a central gallery, where it was chlorinated and pumped to reservoirs on the surrounding hills, whence it is distributed by gravity to the picnic grounds in the valley, and by a pressure tank and pipe lines to camp grounds and buildings on the higher lands.

The sanitation of state parks is also of great importance. Accordingly, much attention is being given to this work by the federal and state authorities concerned with CCC work. Every effort is being made to eliminate the pit toilet and kindred hazards to public health. Incinerators are being provided to burn garbage and rubbish rather than to dispose of it by burial or other obsolete methods, where its leachings will contaminate surface streams and bathing beaches. Comfort stations with flush-type toilets and urinals, the waste from which is handled by septic tanks, are being provided instead of pit latrines or chemical toilets. Effluents from septic tanks are being disposed of through tile fields for subirrigation or by sprinkling filters. In some cases, these are handled by the gravity flow of the effluent; in others, it is necessary to pump this effluent to higher areas or distant locations.

Heretofore, most of the construction work in the state parks has been of the most utilitarian type, due to their rapid growth and development, and only the barest of necessities in shelters and camping and picnic utilities have been furnished. Now, using the labor provided by CCC personnel, shelters are being revamped and at the same time made still more useful. Fireplaces and ovens are being built into the ends of shelter buildings, using native stone or brick with timbers for the enclosure. These structures provide space for night picnicking and steak roasts and also add to the appearance of the buildings. New construction consists of ovens and small picnic shelters of native stone and timbers along trails and in locations where there are beautiful panoramas or vistas.

A few miles of standard road are being built. These roads are short and either provide access to an isolated camp ground or an adequate entrance to an important park. Fire trails are being built to provide fire protection for inaccessible forest tracts in each park.

Bridges that have passed their useful and safe stages and are beyond repair are being replaced. A simple type of rough sawed timber trestle with a concrete road deck has been designed. White oak is being used for the timber portions of the trestle. This type of structure is being used in three parks. Where stone is plentiful, and the span and foundation conditions are satisfactory, stone arch bridges are being built. Two are now under construction, one with a single span of 54 ft. and the other of three spans of 13, 22 and 13 ft. Foot and bridle-trail bridges are of simple hand-hewed timber or rough-stone arch construction. Each type of bridge is designed to meet a particular need and to fit into the prevailing local conditions and landscape.

In one memorial, it was necessary to irrigate a landscaped court to keep the trees, grass and shrubby alive through the dry portion of each summer. The CCC company at this memorial built a dam which forms a 43-m.g. impounding reservoir. A sprinkling system was installed consisting of pop-up and oscillating sprinklers, which should obviate further drought damage.

Several of our state parks have complete topographic maps, while others are either partly mapped or not mapped at all. At those parks that have CCC camps, the topographic mapping is being completed. This assists the landscape architects in their design work and gives the state a complete topographic map of its lands.

Property holdings are being surveyed, and boundaries are being marked in the state parks, that have camps as a matter of protection to the state's holdings. This prevents timber losses and other objectionable trespassing.

FIG. 4—PREPARING CUTOFF TRENCHES for an earth dam. Trenches were carried into the underlying rock and backfilled with clay. The upstream third of the dam was then carried up from these trenches. The completed dam section has slopes of 3 to 1 and 2½ to 1.

General

Virgil M. Simmons is administrative officer of the Department of Public Works and commissioner of the Conservation Department; Kenneth M. Kunkel is director of the division of fish and game; Myron L. Rees is director of the division of state parks and lands and waters; and Ralph F. Wilcox is the director of the division of forestry. Prof. W. K. Hatt, head of the School of Civil Engineering of Purdue University, is state engineer, and the writer is in active charge of the division of engineering.

Spring Dust Frustrated by Winter Windows

Winter windows keep out cold air so much more effectively than the ordinary type, according to government statistics, that the same principle is being applied to dust storms in states west of the Mississippi. The United States Bureau of Standards reveals that double glazing is so effective that fuel savings often are as much as 60 per cent.

The recent experiences in Kansas, Texas, Oklahoma, Colorado and other states were unusually severe, but similar disturbances, less damaging, are nevertheless somewhat seasonable and costly inconveniences, so that double glazing for summer is considered now by a growing number of home owners as a practical all-year protective idea. Double glazing keeps out cold air far more effectively because of the dead-air space between the two panes, and the hot air of summer is repelled by the same principle. Savings to furnishings would quickly repay installation costs, it is stated.

Soil Surveys for Highways in New Hampshire

Classification of soils and methods of recording soil profiles and presenting data for road design and construction in northern states

By John O. Morton
Soils Engineer, New Hampshire State Highway Dept., Concord, N. H.

WITH our knowledge of materials used in constructing highway surfaces, with rigid laboratory tests controlling these materials and with careful inspection in the field of the manipulation of these materials, there is very slight chance for a pavement failure to occur. A large part of our highway troubles, both past and present, are traceable to subgrade conditions and the improper use to which the natural subsoils are subjected. It is true of course that the failure of pavements due to subgrade conditions and the study of subsoils in connection with pavement failures are not new. And it is true that in the past, many subgrade troubles have been remedied during construction, and the methods used have been successful, although, in many cases, the costs have been excessive. But anticipating subgrade failures and designing to meet the conditions presented by variations in the subgrade before the construction period are comparatively new studies.

Soil classification

There are several reasons why a study of subsoils has been neglected. A lack of satisfactory method of soil classification has retarded its development. Such methods of soil classification as have been available have been so complicated and inadequate that they have been more confusing than helpful. It has been an expensive undertaking to obtain even vague knowledge about natural foundation soils. It has been more economical to design to meet general conditions, hoping to catch and eliminate the weak points during the construction period. Such a procedure produces many uncertain conditions to be guessed at by the engineer and contractor, with both suffering as the result.

A few years ago the U. S. Bureau of Public Roads after a great deal of study, provided a suitable means of classifying soils. In general, the procedure is to place soils in different groups, each group presenting a different soil characteristic capable of a definite mechanical action. Of necessity, the group classification has been broad because of its national scope. For an individual state it would be advantageous to subdivide some of the group classifications to meet local conditions. The fact, however, that the bureau has presented a simple and accurate means of soil classification that is applicable nationally for highway construction has proved invaluable. The following is a short description of these soil classifications.

Group A-1—Well-graded material with excellent binder; highly stable under wheel loads irrespective of moisture conditions.

Group A-2—Graded material with inferior binder; highly stable when fairly dry; apt to soften at high water content caused either by rains or capillary rise.

Group A-3—Coarse material only; no binder; lacks stability under wheel loads but is unaffected by moisture conditions.

Group A-4—Silt soils without coarse material and with no appreciable amounts of clay; apt to absorb water very readily in quantities sufficient to cause loss of stability even when not manipulated.

Group A-5—Similar to group A-4 but furnishes highly elastic riding surfaces; appreciable rebound upon removal of load even while dry; elastic properties interfere with proper compaction of macadam.

Group A-6—Clay soils without coarse material; in stiff or soft state absorb additional water only if manipulated; deformations occur slowly, and removal of load causes very little rebound.

Group A-7—Similar to group A-6, but when moist it deforms quickly under load and rebounds appreciably upon removal of load.

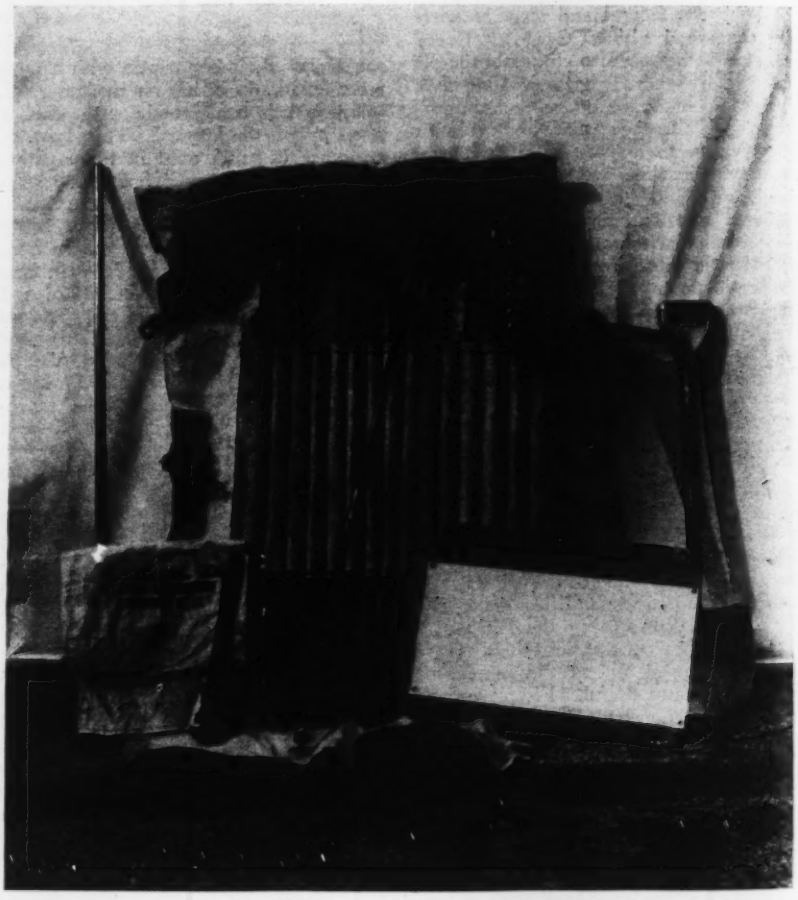
Group A-8—Very soft peat and muck, incapable of supporting a road surface without being previously compacted or displaced by a fill.

The foundation and soil-survey problems of northern states can be placed in three major divisions: first, the determination of soils capable of frost action and of soils free from action; second, determination of the extent and depth of swamp areas; and third, determination of ledge areas beneath top soils.

Frost action

Under the division of soils free from frost action and soils capable of frost

FIG. 1—SOIL-SURVEY EQUIPMENT in New Hampshire is carried in compact container carrying apparatus for borings to a depth of 50 ft.



action, the group classification is carried out in this manner. All cohesionless sands and gravels are placed in the A-3 group. These materials are free from frost action and generally form an excellent base for any type of pavement. In actual practice, cohesionless sands are occasionally found that are very loosely deposited; under such conditions, unless they can be consolidated, they will cause a rough surface where a flexible type of pavement is used.

Soils that are capable of frost action fall into several different group classifications, and from the group classification it is possible to determine the amount of frost action to be expected from the different soil types. The drainage abilities of these soils and the presence of surface water and groundwater are important factors influencing the behavior of these soil types. It is impossible to place a soil in the A-1 group in climates where freezing takes place to any degree, for well-graded soils contain a percentage of fines high enough to be capable of building up some frost action. This would render the material unstable during periods of thawing.

In the A-2 group it has been found practical to subdivide this classification in northern climates as the amounts of fines (that is, silt and clay) that are in this type of material and influence the different degrees of frost action which this material is capable of producing. A-2 material is expressed as a material having insufficient binder to be stable under all conditions. A-2 material, high in silt and clay content, is capable of fairly high frost action, about 6 in. heaving under average conditions, and is classified as a poor A-2 material. A-2 material, with a medium amount of silt and clay binder, is capable of about 4-in. heaving under average conditions and is classified as fair A-2 material. A-2 material, very low in silt and clay content, is capable of about 2-in. heaving under average conditions and is classified as good A-2 material. All A-2 material is greatly influenced by the elevation of the groundwater table and surface water. Heavy rains just previous to the freezing periods increase the amounts of frost action from this type of soil. The types of material that come under this group are commonly known as hardpan, glacial till or ordinary dirt. Side drains are effective in this material.

In the A-4 group the material is silt, while the A-5 group material is an elastic silt. Both of these soil types have high capillary properties, and because of this they are capable of excessive frost action, regardless of the elevation of the groundwater or the presence of surface water. Because of their capillary properties, side drainage is not effective to any extent in these soils. Generally, high frost action will take place in this material even though side drains are present. Heaving of 14 in. on a concrete pavement built on this type of material has been recorded. A side drain was not effective in reducing the heave.

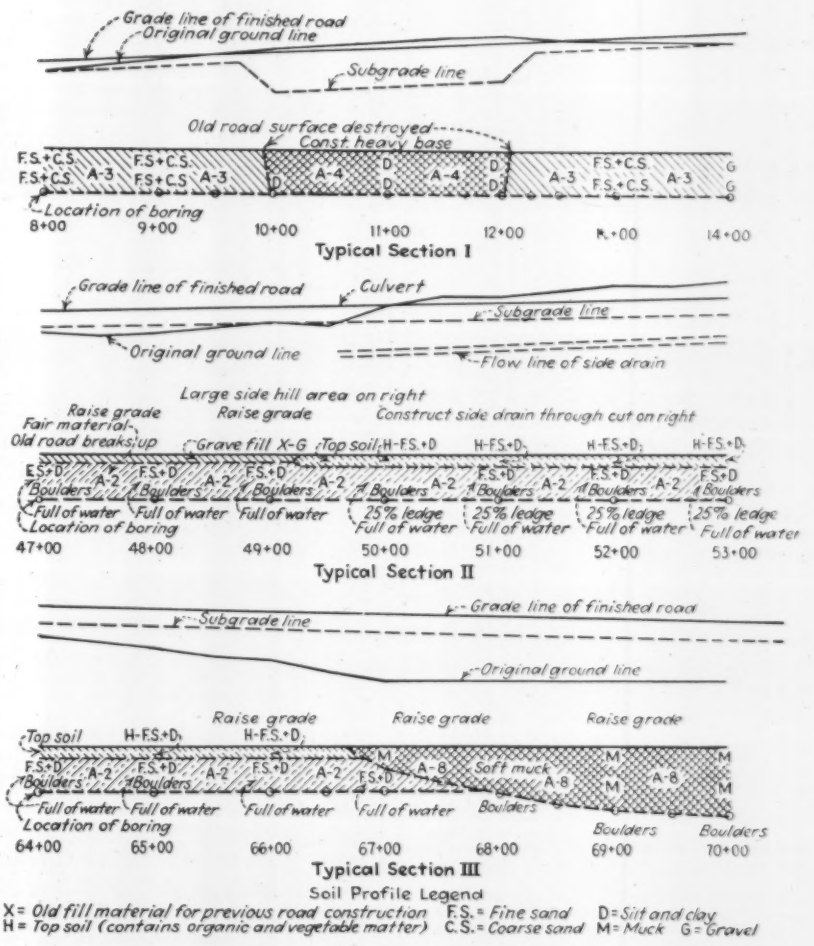


FIG. 2—TYPICAL SECTIONS of a soil-survey profile, showing information as it is presented to the designing and constructing engineers.

In the A-6 and A-7 groups which are clay, excessive frost action can take place. However, capillary action in this type of material is not as rapid as in the silt soils and usually does not produce as high heaving as the silt soils of the A-4 or A-5 groups.

All fine-grained soils may cause settlement of the pavement when used in fill sections. The greater the depth of the fill and the higher the percentage of fines, the more likely are the possibilities of settlement. A fine-grained soil that has been moved from its natural state and placed in a fill requires time to adjust itself. Soils that fall in groups A-2, A-4, A-5, A-6 and A-7 all have possibilities of settlement unless caution is used when placing and manipulating these materials in fill sections. The water content of these soils at the time they are used as fill material also has an imporant bearing on this action. Loss of water from soils, due to evaporation, results in a shrinkage of the volume occupied by the soil mass. Soils that possess capillarity cannot be consolidated thoroughly when wet, as rollers do not produce enough pressure to force water from these soils. It is important that attention be paid to the condition and character of the soil before it is placed in fill sections, and these factors should influence the time allowed to ensue before a high type of pavement is constructed on fill areas.

Swamp and ledge

The determination of the extent and depth of swamp areas presents the second division of foundation problems. All swamp areas are placed in the A-8 group. Knowledge is necessary as to whether the swamp contains a soft or stiff peat or muck, also the amount of sand or earth content of these materials. Soundings should give the exact depth and extent of the swamp area, together with information as to the type of swamp material. This gives the engineer a complete picture of conditions before the project is contracted and enables him to compute accurately the cost of eliminating or constructing over these sections.

Under the third division of foundation problems is the determination of ledge areas. The cost of moving ledge influences, to a large extent, the cost of any one project. In order to estimate accurately the cost of construction for a project, it is, therefore, essential that the amount of ledge involved be known within a fairly close limit. The determination of ledge areas presents a difficult problem. In taking borings it is very hard to differentiate between boulders and ledge when these materials are encountered 4 or 5 ft. beneath the ground surface. Under such conditions the digging of test pits and a careful reconnaissance of the adjacent country are necessary before reliable information can be obtained relative to ledge quantities. Transition points between ledge and subsoils capable of high frost action usually result in destructive frost action, and road design must be adequate to eliminate such conditions.

Soil survey methods

The northern states, which were covered by the ice glacier, have in general the same foundation conditions. Soil types change rapidly, and often a transition from a soil free from frost action to a soil capable of excessive frost action takes place within a few feet. To present an accurate picture of such conditions, it is absolutely necessary that a soil profile be made in conjunction with the engineer's survey.

A preliminary soil profile is occasionally made in advance of the engineer's survey. Such a profile is usually made to investigate swamp or ledge areas that have a direct bearing on the alignment of the proposed road. In general, however, the soil profile follows the completion of the engineer's survey. In making a soil profile the following equipment (Fig. 1) is used: soil augers 4 ft. in length, with couplings and extensions so that they can be increased in length to about 50 ft. for use on swamp areas; picks, shovels, a drawing board with profile paper, notebooks and sample bags. The number and depth of test pits and borings depend upon the soil conditions encountered and the layout as presented by the survey. Generally, where the center line of the new road follows along the old road surface, borings are taken every 100 ft. as close to the new center line as the old road surface will permit. A careful examination of the old road surface will often indicate weak points in the sub-base, which necessitates a more careful investigation.

On the new locations, borings are taken every 50 ft. along the center line, and there are occasions when borings are made along the cross-section line of the survey. Whenever a difference in soil conditions is encountered, borings are taken at shorter intervals, and the

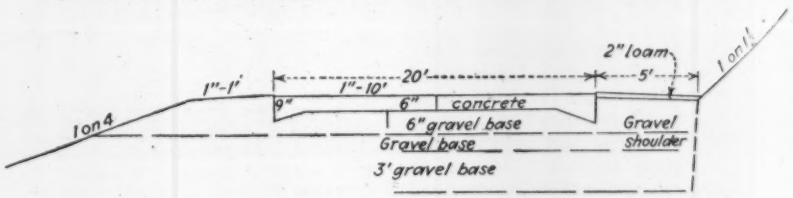
STATE OF NEW HAMPSHIRE

HIGHWAY DEPARTMENT

Preliminary Report on Proposed *U.S.-4* Highway in *Canaan*

Local Name of Road: *Mascoma Valley Road.*
Station *0 + 00* **to Station** *115 + 00*
Plan, Profile and Cross-Sections Received 193
Road Examined *August 30, 31* 1934

1. PRESENT ROAD SURFACE, (a) character (b) width and (c) condition.
The present road is a surface-treated gravel about 18 ft. wide, with shoulders of variable width constructed from the natural subsoil. The present depth of effective gravel varies from 4 to 6 in. The road is highly crowned and has a dangerous alignment. The present road surface is rough in many sections due to substandard conditions, and maintenance costs are excessive.
2. SUBSOIL CONDITIONS within proposed roadway limits.
The natural subsoil varies to a considerable extent. Areas of cohesionless sand and gravel (A-3), hardpan, fairly high in silt and clay content (A-2 fair material), silt (A-4), and a soft muck (A-8) are encountered.
3. GENERAL CHARACTER of material to be excavated, whether loose earth, hardpan, ledge, boulders, muck, etc.
The material to be excavated consists of cohesionless sand and gravel, cemented hardpan, silt, soft muck, boulder ledge and solid ledge.
4. ALIGNMENT OF ROADWAY with recommendations and reasons.
The proposed alignment is acceptable from a foundation viewpoint. From Sta. 67 to Sta. 75 an area of soft muck with a maximum depth of 6 ft. is encountered. The benefits from the proposed alignment more than offset the difficulty that will be encountered by this section.
5. GRADE with recommendations and reasons.
Sections that have a high groundwater table or poor surface drainage have been marked on the soil profile, together with a recommendation for a raise in grade. A raise in grade from Sta. 82 to Sta. 87 will result in a reduction in ledge excavation. From Sta. 15 to Sta. 20 a heavy cut can be made that will provide a large amount of cohesionless gravel. It is recommended that this material be directed to light fill sections.
6. PROPOSED CROSS-SECTION of roadway and type of pavement. Indicate below by sketch and dimensions (a) recommended section of roadway, ditches and slopes, (b) type of pavement, width, thickness and crown.



7. FOUNDATIONS AND SIDE DRAINS RECOMMENDED. List by stations.
From Sta. 0 to Sta. 10; Sta. 12 to Sta. 25; Sta. 28 to Sta. 43; and Sta. 90 to Sta. 115 the natural foundation is a cohesionless sand or gravel (A-3), and a 6-in. gravel base is sufficient. From Sta. 10 to Sta. 12 and Sta. 25 to Sta. 28, silt (A-4) is encountered, and a 3-ft. gravel base is necessary. This base should be placed in one layer to prevent mixing of the natural subsoil with the base course material. From Sta. 43 to Sta. 90 the natural subsoil is a hardpan fairly high in silt and clay content (A-2 fair material), or the road is in a fill over a swamp area or through a ledge cut, and a 12-in. gravel base is necessary. Through cut sections Sta. 50 to Sta. 60 and Sta. 77 to Sta. 80 a high groundwater table together with a large amount of side-hill water is present, and a side drain on the right should be constructed.
8. LOCAL MATERIALS, borrow, gravel, sand, loam, etc. Give location, quality and estimate of quantity available for such materials as may be required for this project, exclusive of pavement materials.
Suitable borrow can be obtained from a bank on the right at Sta. 20 and from the Holmes pit on the left at Sta. 100. Gravel for base can be obtained from the Webster pit located 0.6 miles south of Sta. 0. The Webster pit contains Class B gravel.
9. PAVEMENT, MATERIALS. Give locations or other sources of supply for such materials as concrete aggregate, broken stone, surfacing gravel, crushed gravel, etc., as may be required for this project.
Pavement aggregate will probably be supplied from a commercial plant. The Vogel and Hadley plant at West Lebanon is within 20 miles of the project and rail facilities are available within 0.5 mile of the project.
10. DRAINAGE, box culverts not exceeding 6x6 ft. in size. Pipe culverts, and catch basins. List structures by stations, and in case of culverts give approximate angle with center line at point of crossing. In case easements are required, special mention should be made under this heading.
No Suggestion
11. STRUCTURES, exclusive of bridges but including retaining walls, sidewalks, curbing, paved gutters, curb inlets, special culvert ends, etc. List by stations and describe fully so that suitable designs can be prepared.
No Suggestion
12. GUARD-RAIL. Recommend type and list locations by stations.
No Suggestion
13. PUBLIC SERVICE POLES, conduits, and underground structures of municipalities. Where changes are involved describe fully.
No Suggestion
14. LEDGE. Thorough consideration must be given to this item, and sufficient investigation made to determine likelihood of encountering this material in excavation. Percentages of ledge and boulders in cuts must be estimated with care.
Boulder ledge will be encountered from Sta. 50 to Sta. 67 and Sta. 75 to Sta. 82. Excavation through these sections should be figured as 25 per cent ledge. Solid ledge will be encountered between Sta. 82 and Sta. 87.
15. SHADE TREES. List by stations all roadside shade trees which will require removal.
No Suggestion
16. EXTRA WORK. Whenever it appears that work may be done as extra, such items must be listed and an estimated cost of each item given.
No Suggestion
17. TRAFFIC. State whether road is to be kept open to through traffic or detour provided. In case of latter give description of detour and length in miles.
No Suggestion

REMARKS:
Attention is called to the swamp area between Sta. 67 and 75. It is recommended that the muck be excavated. The fill should be thoroughly compacted and allowed time to settle and adjust itself before the pavement is constructed over this section.

FIG. 3—REPORT FORM and sample report submitted with soil profile by soils engineer.

transition point between the different soil types is located. The depth to which borings are taken is usually 4 ft. However, where a heavy cut is expected, borings are made to greater depths, and through swamp areas the borings (to be of any value) must show the depth and extent of the swamp area. The reason 4 ft. has been taken as the average depth of the boring is that the maximum frost penetration beneath northern roads is somewhere near that figure; and for a soil profile to be accurate, knowledge of the foundation subsoil should be obtained to a depth equal to the maximum frost penetration.

Soils are generally classified by visual inspection into the various groups. A man trained in soil classification will readily recognize most soil types and place them in the different group classifications. On certain soils that can be called border-line materials, laboratory testing is necessary for accurate group classification.

As the soil profile is being made, other foundation conditions are recorded. The general water content of the soil, surface drainage conditions and the amounts of base-course material that have been used for previous road construction are all noted (Fig. 2). When the soil profile is turned over to the designing engineer a report (Fig. 3) is filed with him that recommends various depths of base course necessary to meet changes in the natural subsoil conditions, the location and extent of side drains, changes in grade that would prove beneficial from a foundation viewpoint, percentages of ledge to be estimated for various cut sections, and any special information that would pertain to the natural subsoil conditions or uses of such material.

With the development of the soil profile to its present status and the practical application of this knowledge of subsoils, one more gap is being closed in the modern science of highway construction. Each year sees soil work being constantly increased. The maintenance, design and construction of highways in an intelligent manner demand a thorough knowledge of the natural subsoils and their practical application to highway programs.

Ten Years of Road Work Planned for Maryland

State planning commission specifies 906 miles of road, 60 bridges and 57 crossings in ten-year modernization program and lays down governing principles

MARYLAND, one of the few states that have substantially completed federal-aid and state highway systems and one of the early (1908) states to create a highway commission, now takes rank as one of the first states to undertake and report an advance plan for highway improvement. This plan, recently made public, provides a ten-year highway construction program. It is the work of the Maryland State Planning Commission created by the state legislature in November, 1933; the commission considered only the construction program, leaving for another report all consideration of the cost of the program and of the method of financing it. Abel Wolman, chief engineer, state department of health, is chairman of the commission, and H. D. Williar, chief engineer, state highway commission, is chairman of the subcommittee on highways, which drafted the report.

At present, Maryland has a state highway system of about 3,300 miles, of which 100 per cent has been improved and about 85 per cent has been paved. Considering this system, the report states that early activites consisted of an improvement of existing wagon roads, and did not include planning a highway system on the basis of any anticipated traffic volumes and lines of flow. With minor revisions in detail, this policy of improving previously existing roads by applying durable surfacings, and in some instances increasing widths, is even up to the present time the dominating influence in the work of programming the construction.

Program recommended

The conditions indicated have created a need, states the report, for a "comprehensive, long-term plan for highway development." Traffic counts indicate a large mileage of roads in urgent need of re-aligning and widening, to carry present traffic safely. This improvement should be prompt, but should be limited to roads that fit into a planned arterial system. It is believed that the next ten years can be spent most profitably in bringing by reconstruction these different routes into condition to meet developing traffic demands. This program of improvement as outlined is shown by the accompanying map and includes 906 miles of road, 60 bridges and 57 grade-crossings.

The report prefaces its specific project recommendations with a discussion of location, traffic records and right-of-way policies. In regard to location, the report points out that the future development of the state will probably be mainly along commercial and industrial lines. As there are sections that obviously lend themselves more readily to such development, studies should be made to anticipate as far as possible their character and extent. It is also necessary to give consideration to plan-coordination with the road sytsems of adjoining states.

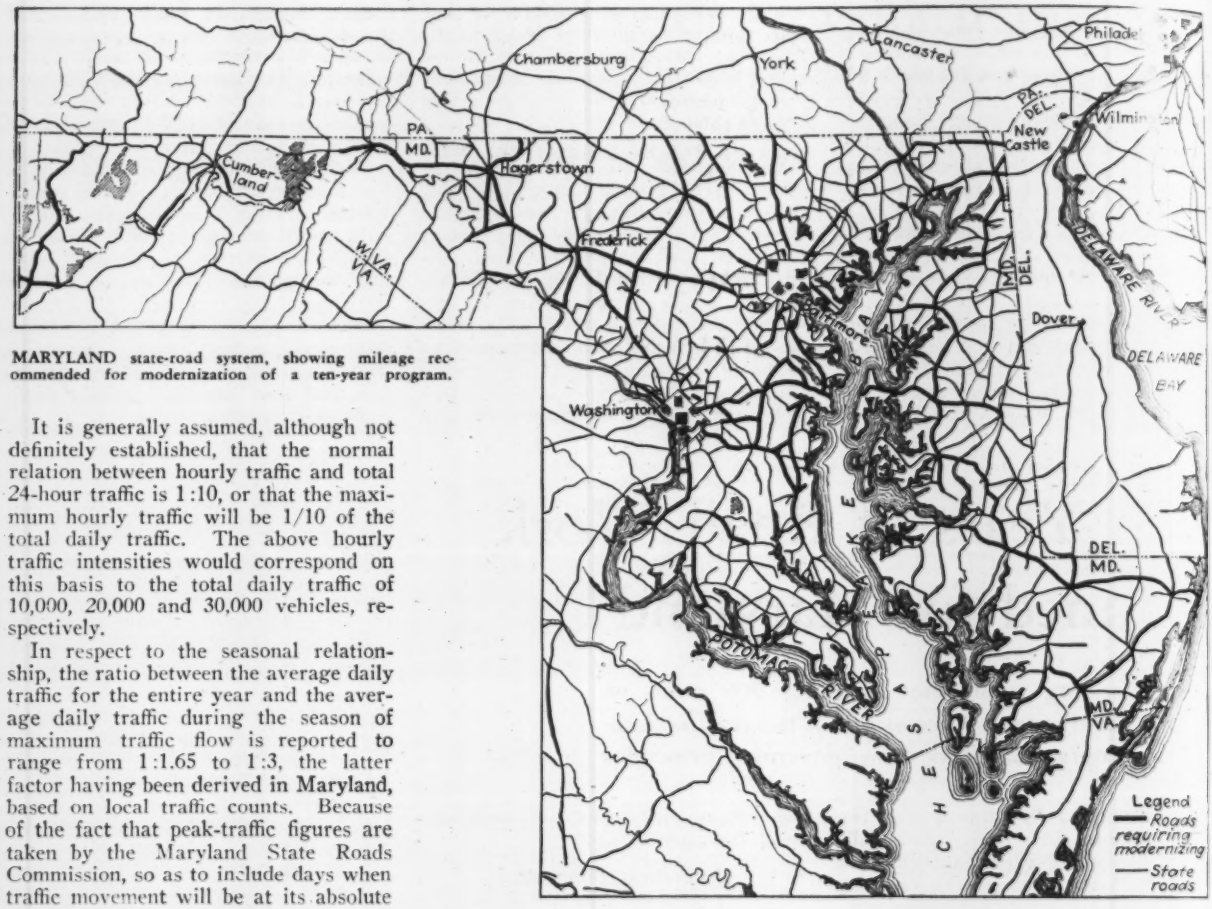
Traffic-volume studies are essential not only to determine existing traffic but also potential traffic, based on population served and the probable stimulating effect of the proposed improvement. Too great stress, the report says, cannot be laid on the necessity of continuing comprehensive traffic studies.

Specific requirements for right-of-way are not stated, but the report urges that past experience has indicated the necessity of "generous right-of-way widths for highway purposes." Proper provision in this respect provides space for future widening, without involving the destruction of roadside buildings and other improvements; prevents the encroachment of roadside structures, and thereby avoids danger to the traveling public; provides the possibility for wide earth shoulders, and avoids the growth of dense underbrush, hedge fences, etc., adjacent to the road metal.

Traffic-lane determination

The width, arrangement and number of traffic lanes must be carefully fitted to the requirements of the amount and type of traffic that will use the highway. For the present, it seems to be well established that traffic lanes for any type of traffic should be not less than 10 ft. in width, and there is a "growing opinion that where commercial vehicles constitute an appreciable percentage of the traffic, the lanes should be somewhat wider."

As to the number of lanes required for various intensities of traffic, the reports of Dr. A. N. Johnson, dean of engineering, University of Maryland, in cooperation with the Maryland State Roads Commission, appear to contain as accurate a statement of traffic capacity as is available. These traffic-capacity studies indicate that the congestion-free capacity in vehicles per hour of various numbers of traffic lanes are as follows, including both directions: two lanes, 1,000; three lanes, 2,000; and four lanes, 3,000. To apply these factors to various average traffic flows, it is necessary to consider the hourly variation in traffic during the day and the seasonal variation of traffic during the year.



MARYLAND state-road system, showing mileage recommended for modernization of a ten-year program.

It is generally assumed, although not definitely established, that the normal relation between hourly traffic and total 24-hour traffic is 1:10, or that the maximum hourly traffic will be 1/10 of the total daily traffic. The above hourly traffic intensities would correspond on this basis to the total daily traffic of 10,000, 20,000 and 30,000 vehicles, respectively.

In respect to the seasonal relationship, the ratio between the average daily traffic for the entire year and the average daily traffic during the season of maximum traffic flow is reported to range from 1:1.65 to 1:3, the latter factor having been derived in Maryland, based on local traffic counts. Because of the fact that peak-traffic figures are taken by the Maryland State Roads Commission, so as to include days when traffic movement will be at its absolute maximum, it is felt that the 1:3 seasonal relationship is higher than should be provided for in highway design.

A recent survey in the Washington, D. C., regional area indicated a ratio of 1:1.71. It seems that the ratio of 1:1.7 is reasonable, in view of the above, and that it may be applied properly to Maryland roads.

The above-noted daily traffics must be divided by 1.7, therefore, to convert them into terms of annual average daily traffic capacity. It would appear then that an average daily traffic of 6,000 vehicles is the capacity of a two-lane road; 12,000 vehicles of a three-lane road; and 18,000 vehicles of a four-lane road.

Highway lane arrangement

Arrangements of traffic lanes are a subject of debate among highway engineers in regard to roads containing more than two lanes. The safety of the three-lane road, involving as it does a middle lane, subject to the use of traffic going in either direction, is causing much concern. In rolling country the three-lane road is likely to be dangerous, with the continuous likelihood of head-on collisions in the center lane. Where topography is such that sight distances of 2,000 ft. or more may be obtained, the three-lane road would be relatively free from this danger. The three-lane road cannot be widened into a dual four-lane road, and, consequently, is not advisable where future development of traffic may require this type of construction. For four-lane roads it appears to be essential, for the safety of the traveling public, that such roads be constructed as dual highways, with an adequate separation between the two-lane traffic ways.

Special hazards

Along heavily traveled routes it is desirable to collect lateral traffic on access roads paralleling the main road and to feed it into the main traffic stream at fairly distant intervals. This involves the construction of low-type access roads paralleling the main road at a short distance. Such roads should be provided wherever the annual average traffic flow exceeds 10,000 vehicles per day. Their design is that of any light-traffic lateral road.

The frequency of pedestrian fatalities along highways indicates that provision for greater safety is necessary. Sidewalks along roads serving pedestrians as well as vehicular traffic are a simple and entirely effective means of safeguarding life; it is recommended that on roads where pedestrian use warrants it, walks be provided as a part of the state highway construction.

Inspection of highway-railroad grade-separation structures in Maryland shows that in the past insufficient attention has been given to the location of the highway at these points. In some cases, the alignment of the highway has been so impaired by the new structure as to introduce a hazard almost as serious as the railroad crossing that was eliminated.

Economy in first cost has apparently been allowed to govern the location in these cases. Proper location of the highway should be provided in all future structures built. If at highway intersections the traffic density warrants separation, the clover-leaf type of design affords an excellent solution.

Proposed program

The paramount need at the present moment is for the reconstruction and modernization of a considerable mileage of roads on the state highway system. Unplanned as these roads were in their original location and construction, they are carrying traffic far in excess of their safe capacity, with existing lines, grades and widths. Consequently, the modernizing of such routes is of fundamental importance. In selecting roads for improvement the fundamental factor is their being or becoming a part of the planned state system of arterial

highways. After this fundamental selection, the existing roads have been scrutinized with respect to four characteristics:

1. Roadway width, insufficient for traffic volume or less than the 20-ft. minimum safe width.

2. Sight distance too short for safe driving at present-day speeds.

3. Curves badly laid out or of too short radius.

4. Earth shoulders too narrow for safety, due generally to inadequate right-of-way width.

The modernizing for one or more of the above reasons of 906 miles of existing roads is called for. These roads are shown on the accompanying map.

Local Construction Coordination to Improve Code Administration

Special Correspondence

THE PROBABILITY of extension of the National Industrial Recovery Act, with extension or re-enactment of existing codes of fair competition, has emphasized the importance of studies that have been under way for some months by the Construction Code Authority of the possibilities and benefits of local integration of code administration.

These studies took tangible form last August upon the request of the National Recovery Administration to the Construction Code Authority to consider the coordination and consolidation of local administrative agencies under the several chapters of the code. Although the point is frequently misunderstood, the Construction Code Authority is not responsible directly for the administration of the code among the members of the industry but is primarily a coordinating and planning agency. The divisional code authority created under each particular chapter, of which there are now 21, administers the code among the members of that division. The code, in such case, comprises the specific divisional chapter, and Chapter I involves the general provisions.

The problem of joint facilities

At the meeting of the Code Authority held in Chicago on Aug. 17, 1934, a committee on joint facilities was created. It has held many meetings during the succeeding six months from which resulted a recommended program of joint facilities. The program was approved in principle by the Code Authority in December, and upon its completion as to detail was sent to the divisional code authorities for comment, and later to the temporary coordinating committees (of which there are 50, established about a year ago, one in each NRA compliance district, with a membership embracing the various divisional groups).

The joint facilities committee was picked to represent adequately the professional group, the general contractors and the special contractors. It is comprised of Stephen F. Voorhees, chairman; William Stanley Parker, representing the professional divisions; A. E. Horst, representing the general contractors division; L. W. Davis, representing the mechanical trades divisions; and H. R. Cole, representing the trowel and finishing divisions. In order to receive the benefit of the special knowledge of governmental practice, Prof. William S. Carpenter and Harwood L. Childs, of the department of politics, Princeton University, were retained as consultants.

There has been no formal action by the Construction Code Authority with respect to modification of the code structure to embrace the features of the study. It is understood that some divisional groups oppose the tentative program as infringing upon divisional autonomy guaranteed by the code in its present form. Several divisional groups, which are small and compact and operate through a national office with no local committees or agencies, would not benefit appreciably from the program.

Certain other divisional groups are heartily in favor of the proposals, and this seems to be particularly true of those that have no well-organized industry groups or trade association chapters in centers of population. The Code Authority has made a special study as to the application of the program in New York City, but it is reported that sentiment there is generally unfavorable, although the program has not been placed before the entire industry. A study by the temporary coordinating committee in Boston has indicated various objections, but the sentiment of temporary coordinating committees in other large cities is much more favorable.

At NRA, on the other hand, there is much interest in the proposals as serving to lessen divisional differences in localities, and particularly to prevent the duplication of administrative facilities and to reduce code costs. Consideration at this time of the extension of the budgets for three large divisions, two of which exceed a million dollars each, and the imminence of the consideration of budgets for all other divisions (expiring on June 16) has brought about a concentration of attention on proposals to simplify the code structure.

National integration and unification of the construction industry was affected by the code itself. The next logical step is local integration within compact trade areas, in order that financial resources may be conserved, duplication of activities obviated and the efforts of the industry concentrated.

Effective administration is obviously contingent upon good local administrative facilities—for filing duplicate copies of bids, for investigating and determining trade-practice complaints, and for registering construction work or services. In the belief of those who have studied the administrative problem, these and other facilities can best be obtained through concerted action of the various divisions.

The necessity of local coordination was recognized nearly a year ago by the Construction Code Authority when it provided for the appointment of temporary coordinating committees in each of the NRA compliance districts, some 50 in number. Each division of the code was requested to appoint a member on the various committees, and the Construction League was to designate a temporary chairman who would serve until the committee had met and elected permanent officers. Initially, these committees were expected to serve as sources of information as to the code, particularly pending the time when divisional chapters should have been approved by NRA and local administrative committees appointed by the Divisional Code Authorities.

From time to time, the coordinating committees have been requested to perform specific functions, such as cooperating within their territories with the Home Owners Loan Corp. and the Federal Housing Administration. Some of these committees have been conspicuously active and effective in promoting understanding of and compliance with the code, securing the cooperation of public and private awarding authorities, and coordinating the efforts of divisional administrative committees. Several of them have appointed branch coordinating committees to serve particular communities, or have assisted in the establishment of joint bid depositories and other joint facilities.

The Construction Code Authority views the local code council as the logical development from the temporary coordinating committee. Local code councils should be established to meet the requirements of the industry in various sections of the United States, and might be created in any locality that is a natural construction center. What constitutes a "local trade area" cannot be defined arbitrarily, but must grow out of the opinions and needs of the different divisions of the industry. It is unnecessary that all divisions of the industry be represented in every local code council, except that all divisions operating through administrative committees in the particular territory should be represented. Territories of the various local code councils should be so defined that there would be no overlapping of jurisdiction.

Economy will dictate that there be no more councils than necessary to secure efficient administration. While the precise number that may be required cannot be stated, it has been roughly estimated at between 200 and 300 for the entire United States. Once the exact locations are determined, the territories of these councils can be expanded to blanket completely the 48 states.

The membership of the council would comprise representatives of divisions of the code which have administrative agencies or representatives in the local area, plus other representatives for non-divisionalized groups (including the architects and engineers, for which chapters have not yet been approved). Because of the predominance of special contractor representatives on such local code councils, the number of representatives from the professional groups and general contractors is somewhat increased, but a provision is suggested for balanced voting as between the professional group, general contractors and special contractors.

Unless unanimous agreement is reached in the council as to allocation of votes, the voting ratio is to be 2 for architects and engineers, 3 for general contractors, and 4 for special contractors, Further, provision is made for balanced panels of five members each for the purpose of deciding cases referred to the Council, in the ratio of 1, 2 and 2 members from the three groups. Appointment to the code council is to be made by the Construction Code Authority, in the case of divisional and subdivisional representatives, from nominations by the respective divisional code authorities.

Make-up of local councils

A suggested constituency for the code councils is as follows:

Professional Group Representatives—(4)

Architects	2	Engineers	2

General Contractors' Representatives—(6)

Divisional	3	Heavy and R.R. contractors	1
Building contractors	1	Highway Contractors	1

Special Contractors' Representatives—(22)

Painting, paperhanging	1	Insulation	1
Elevator	1	Terrazzo and mosaic	1
Cement gun	1	Heating, piping	1
Roofing and sheet metal	1	Marble	1
Electrical	1	Plastering and lathing	1
Masons	1	Stone setting	1
Tile	1	Building granite	1
Plumbing	1	Cork insulation	1
Kalamein	1	News service	1
Wood flooring	1	Non-divisionalized	2
Resilient flooring	1		

A suggested form of charter for the local code council is embodied in the program. It defines the area under the jurisdiction of the council, membership and voting as discussed above, and duties are as follows:

(*a*) Cooperate with the divisional committees in adjusting trade-practice complaints and securing compliance with the code.

(*b*) Supervise official joint bid depositories and recommend to the Construction Code Authority changes for improving these depositories.

(*c*) Provide for registration of construction work or services and collect code assessments for the divisional code authorities unless such function is performed directly by the divisional headquarters. In the latter case, the code council shall assist in making the collections.

(*d*) Provide secretarial facilities for divisional local administrative committees, if desired.

(*e*) Conduct educational programs to promote the widest possible understanding of and compliance with the construction code.

(*f*) Engage in such other code activities as may become necessary and are authorized by the Construction Code Authority.

Operation of the councils

No definite plan is presented for financing code council operations. It is suggested that the most logical means of support of these coordinated administrative facilities is through contributions by the participating divisional field agencies from the funds allocated to them from divisional code assessments. In the first instance, the amount of such contributions would depend upon the extent to which the code council is authorized to perform the functions of the various administrative agencies. Obviously, the pooling of divisional funds in a particular area, however meager, would furnish a sum sufficient to support a fair degree of coordinated effort.

The program does not propose that the panels in the code councils shall displace the trade-practice complaints committees appointed by the various divisions, unless a division so desires. However, a complaint case involving only one division may be referred optionally to the code council to bring the advice and influence of the entire construction industry to bear upon the question. When such a complaint involves more than one division, the adjustment reached by the two divisional committees would, of necessity, be submitted to the code council. Divisional trade-practice complaint procedure ordinarily would require that complaints which cannot be adjusted with this local handling be referred up the line for review before going to the compliance division of NRA. Some industry leaders would favor shortening this process in the interest of quicker handling of the prosecution of such cases, feeling that persuasion should end in the locality, and the more quickly any case requiring prosecution is placed in the hands of the U. S. District Attorney, the more effective the code will be.

Joint bid depositories

A separate part of the joint facilities program sets forth suggested rules and regulations for establishment and operation of official joint bid depositories by the Construction Code Authority, in which all members of the industry shall file duplicate bids. These rules and regulations are a compilation of the best points of the various divisional plans now in operation, and were written with the future in mind when there might be a uniform set of rules for all divisions. For the present it is stated that joint bid depositories, if established, must be operated in accordance with the approved regulations of those divisions which use the joint depository.

Already there has been a noticeable trend toward using such joint depositories from widely scattered sections of the country. The most talked of case is that of the San Francisco central depository, established through the efforts of the temporary coordinating committee in that city. Seven divisions of the industry were using this depository at the last report. There is a distinctive system of locked file drawers which are opened by the proper administrative officials and bids tabulated in accordance with divisional requirements. While the territory covered is, in most cases, the northern half of California, the central depository is establishing subsidiary depositories under its general supervision and control in certain outlying towns. The central depository is coming to be the center of code activities in that area.

Nine divisions are using a central bid depository in Cleveland, carried on under direction of a committee appointed by the temporary coordinating committee. Bids are deposited here by general contractors, painting contractors, electrical contractors, roofing and sheet-metal contractors, mason contractors, plumbing contractors, terrazzo and mosaic contractors, insulation contractors and plastering contractors. Only two divisions that have local depositories are operating separately, while the remaining ten divisions of the code either do not require local depositories or have not established them.

In Wilmington, Del., eight divisions use a joint bid depository, and the ninth division is to be added shortly. Eight divisions file bids in a joint bid depository in Birmingham, Ala., while depositories in several other cities in Alabama serve more than one division. A joint bid depository in Louisville, Ky., serves seven divisions, with a separate depository established for only three other divisions. Nine special contractor groups file bids in a joint bid depository in Indianapolis, with only one other division having a separate depository.

These are typical of many instances of the establishment of joint bid depositories, brought about through the efforts of members of different divisions in one locality in the interest of simplicity of code administration, coordination of effort and reduction of expense. Under the local council system, the joint depository would become regular practice.

Nation's Water Problems Discussed by Waterworks Men

Drought, corrosion, pipe, equipment, chemicals, operating technique and financial control among subjects considered by 900 engineers and officials at American Water Works Association convention

FORTY PAPERS and a symposium on each of four vital water problems as well as two round-table discussions made up the bulk of the program of the Cincinnati convention of the American Water Works Association, May 6 to 9. Attendance at 900 topped most of the recent convention records and indicates returning prosperity, which the waterworks manufacturers foreshadowed by exhibiting in one of the largest displays the industry has seen. The comparatively new financing and accounting division vied with the purification division for intensity of interest, but the management and operation division was not far behind with its two round-table discussions. Thus the association appeared better balanced as to activity than ever.

At the business session a budget of $68,000 was adopted. Frank A. Barbour, Boston, was elected president, and W. W. Brush, New York, was re-elected treasurer. The membership decline of the depression years has been checked, and the curve is now on the upgrade. Some 300 new members have been added in a campaign begun the first of the year. The Franklin Henshaw prize for that section which registers the greatest percentage attendance at its meetings was announced and awarded to the Montana section. The Virginia section received the Nicholas S. Hill prize for the greatest increase in members. Frank E. Hale, New York water department, received the John M. Goodell Prize awarded by *Engineering News-Record* for a notable contribution to waterworks science and practice in the form of a paper on pipe corrosion; and Linn H. Enslow, editor *Water Works and Sewerage*, was the recipient of the John M. Deven Medal for outstanding service to the association. The 1936 convention will be held in Los Angeles.

Amendments calculated to increase the representation of the manufacturers on the board of directors from one to three were sent to letter ballot after a discussion of the advisability of revamping the whole method of selecting the directors and reducing the number by a system of elections from districts, rather than one from each section, which makes a large unwieldly board. A committee to develop a suitable memorial to perpetuate the memory of George W. Fuller, was authorized.

Of the general subjects, drought, national planning, waterworks financing and public works claimed particular attention. A symposium on three California dams, O'Shaughnessy, Morris and Bouquet, one on suppression of mine wastes, one on corrosion and another on protective coatings of pipe were the technical high spots. The purification division as usual covered carefully detailed chemical and bacterial procedures. The finance division program ranged from sales tax, rates, appraisals, to collection and accounting methods and a start toward adoption of uniform classification of accounts. The plant management round-tables covered such topics as billing methods, services, storage yards, meter improvements and tampering, public relations, emergency organizations and inspections.

Round-table topics

Stub billing appears to be on the increase. The inclusion of delinquencies on mailed postcard bills is permitted by the postoffice officials in some sections. In Oklahoma City T. G. Banks divided the city into 22 districts, and bills go to one district each working day; this procedure permits making a trial balance in two days against two weeks by the old ledger system.

With respect to meters, there is room for improvement in stuffing boxes according to H. W. Niemeyer, Indianapolis Water Co. Also, the thrust on the spindle, the friction of the ball socket and the clearances in the disk chamber need attention, he stated. H. W. Griswold stated that the present-day meters generally are in advance of specifications, indicating perhaps that specification should be strengthened.

Meters larger than 2 in. are being replaced in many cities by a battery of small meters. Memphis made experiments hooking up a battery of 2-in. sizes back of a 3-in. size, getting better results. A special header was devised.

H. L. Meites instanced an organized attempt in Chicago to cut meter readings of large consumers by gear interchange. Thirty cases were found and convictions made. Back bills were ordered paid by the court.

Ownership of fire hydrants by fire departments, as at Cincinnati and Detroit, is rare and in nearly all cases inspection and maintenance are the responsibility of the water department, according to a discussion on the subject of divided responsibility.

On emergency organizations various schemes are in vogue to keep track of men off duty in the smaller cities, and elaborate equipment and crews on 24-hour service are usual in the larger cities. In Manhattan, New York City, three gangs are always on duty. Short-wave police radios are used in Syracuse, N. Y., to maintain contact with repair crews.

Damage liability from flooding due to broken mains is rarely considered valid by the courts, stated W. W. Brush.

Drought

Earnest Boyce, Kansas State Board of Health, described the drought relief service in his state (*ENR*, p. 181, Aug. 9, 1934). The educational effect of the drought on officials has been excellent in waking them up to the necessity of planning and providing future adequate supplies, said Professor Boyce. He warned against haste in construction, without adequate study and investigation of all sites, geology and engineering factors, and he deplored the lack of water-resource statistics in great areas.

On the same subject, W. H. Knox, Ohio state department of health, indicated that 1934 was the fifth consecutive year below normal. Although 1934 rainfall was only 26.6 in., cities were not so acutely affected as in 1930 (rainfall 27 in.), since storage had been provided and wells deepened in many places. He warned against expecting to increase groundwater levels over any large areas by surface storage.

Thorndike Saville, New York University, deplored the lack of statistical information on water resources, indicating that while we had 4,500 precipitation stations we only had 200 recording gages. We lack small-stream data. He suggested that an FERA project might supply added facilities. On evaporation we have only 100 stations, 90 of which are west of the Rocky Mountains. Snow surveys have been made for less than ten years and only one or two states have made a concerted effort to collect reliable statistics on groundwater levels or on the chemical and physical characteristics of groundwater. The support of AWWA was requested in developing central control of water resources, outlined as essential in the report of the National Resources Board.

Long-range planning

As a corollary subject to the drought, the subject of water planning on a national scale was taken up by Morris

L. Cooke, consulting engineer, Philadelphia. Couched in sensational language, Mr. Cooke's analysis of our poor agricultural management provided background for his outline of a large-scale, long-range program of water planning involving as an estimate $500,000,000 of federal money annually, to be used in developing river systems as a whole instead of piecemeal, and looking eventually toward combining the separate problems of water and of land conservation into a single problem.

His conclusions followed closely those of the National Resources Board, as recently published. "The current emergency," said Mr. Cooke, "is more than one of unemployment. It involves ultimate survival. The dust storms and droughts of recent months have served poignant notice that unless we change our agricultural ways this country of ours has left to it less than 100 years of virile national existence and perhaps only twenty years in which to set up the defense against the creeping paralysis of soil erosion." Engineers not only should appreciate this situation but also should recognize its social and political implications. "Competent and bold planning, adequate spending and a spirit of high devotion are needed. Engineers must seek appropriations that will supply complete mastery of all water problems and related activities such as flood control, erosion and low-water control, navigation, irrigation, forestry and far-flung electrification for pumping and agricultural uses," Mr. Cooke concluded.

In commenting on the papers of Messrs. Cooke and Saville, Frank A. Barbour stressed the need for cooperation but warned against the extension of federal bureaucracy control into waterworks systems, with the danger of political abuses. Abel Wolman called attention to England's 7,500 rain-recording gages. The board of directors authorized the appointment of a committee on national water policies, to handle such problems as may arise.

The public-works program

In an analysis of the current situation in the public works program, Malcolm Pirnie, consulting engineer, New York, made a special plea for decentralization of non-federal project management as the only way that necessary speed in stimulating construction can be attained. As part of this decentralization, Mr. Pirnie recommended a procedure destined to return the nation to normal methods of public improvement by private agencies. The only alternative to decentralization seems to be a gigantic CWA-type program, which would smother private agencies into non-existence, so that when the present money is gone normal activities will be too thoroughly disrupted to be resumed.

Mr. Pirnie suggested a plan which he says has received careful study: The President would ask communities to start immediate normal planning and construction of their most needed public works, requiring only a state board approval and an estimate of cost to be filed. The federal government would agree to reimburse each community 50 per cent of expenditures made prior to Dec. 31, 1935, 30 per cent of expenditures during the following nine months, and 20 per cent of expenditures during the balance of the relief-works program. Such a plan, it is believed, would stimulate speedy work, would decentralize operations and serve as a guide back to normal methods of activity.

For waterworks improvements, Mr. Pirnie felt that the plan was particularly advantageous. Water consumption is sure to swing back above normal, necessitating considerable expansion and improvements. Since costs of materials and labor will go up at that time, present bargain prices should spur waterworks officials to build now.

With respect to the potential status of the public-works program, Mr. Pirnie said that the federal government is not organized to plan and execute construction substantially in excess of half a billion dollars a year, exclusive of the federal-aid highway service, so that immediate decentralization of the bulk of the program by placing responsibility for specific planning and execution wholly upon the local communities is an essential requirement. Local government and private agencies exist in more or less skeleton form, which handled effectively, as recently as 1929, more than one billion dollars worth of construction a month. They can now be depended upon to handle a mere quarter of such volume, and if not given the opportunity to do so cannot live to carry on effectively when the present program ends.

Water purification

"Determining the Bacteriological Quality of Drinking Water" was the title of a paper by C. T. Butterfield and J. K. Hoskins, both of the U. S. Public Health Service, dealing primarily with the mathematics of expressing the results of presumptive tests for B. coli and B. aerogenes. They pointed out the errors of present methods and recommended the use of "the most probable number" as determined from a series of tests using like quantities of the water tested. They also demonstrated methematically that there is an optimum size of sample for various concentrations of organisms in the water being examined. Though the mathematics are somewhat complicated, the optimum size of sample and the most probable numbers can be taken from straight-line curves on logarithmic paper. No differentiation between B. coli and B. aerogenes was favored because both are common in human intestines.

The discussion dealt largely with the possibility of obtaining direct counts on plates, using appropriate media. Some believed that such media can be developed and urged further work along this line. However, a criticism was that the method required too much culture medium and too much glassware, especially when the optimum quantities of water are large. For relatively pure waters the optimum quantities may be as much as 100 cc. It was also pointed out that plate counts after 24 hours' incubation at 37 deg. C. "whitewash" results obtained at filter plants. Incubation for 48 hours and at lower temperatures give much higher results.

W. C. Purdy's paper on "Results of Algal Activity" presented results of experimental work to determine the extent of re-oxygenation produced by algæ. Quantities of sterile water were prepared with dissolved organic matter that would serve as food for bacteria and algæ. Water inoculated with bacteria became devoid of oxygen. Water inoculated with algæ increased in oxygen content to supersaturation. Water inoculated with both bacteria and algæ at first lost oxygen and later increased in oxygen content to near saturation and remained in this condition to the end of the experiment. The significance of the tests is that relatively clear waters may derive large quantities of oxygen from algæ, this oxygen becoming available for maintaining an excess of oxygen during "self-purification" of the water. Further studies are necessary to determine to what extent algæ-produced oxygen can be counted upon in considering stream-pollution problems. By reason of the fact that algæ-produced oxygen is liberated at considerable depths under pressure it becomes more readily available than oxygen absorbed from the atmosphere at the water surface.

Mr. Purdy, in commenting on the toxic effects of certain algæ, mentioned laboratory experiments on animals and several epidemics of bowel disturbance caused by exudation products of algæ in concentrated amounts. The discussion brought out several cases of cattle poisoning by concentrations of anabena. A. E. Berry described shore accumulations of windblown algæ which, upon decomposition, produced bad odors and resembled sewage sludge.

Coal—Recently, due to the various experiments on filter materials and a better understanding of washing procedure plus scientific methods of sizing, renewed interest in anthracite coal as a filter material has sprung up. E. L. Buller, research engineer, Hudson Coal Co., described the sizing operation employing the Rheolaveur process used extensively in preparing European coals. F. W. Green stated that he had recently filled a ½-m.g.d. filter unit with coal at the Little Falls (N. J.) plant, to remove a heavy concentration of algæ at a high rate. Its advantage is its light weight (55 lb. per cubic ft.) and angular shape, which gives larger

porosity (51 per cent against 44 per cent for sand). It does not pack so hard as sand, and it can be washed with a lower vertical rise of washwater. John R. Baylis claimed that a higher rather than a lower specific gravity was needed to prevent mudballs from working down into the bed. S. T. Powell felt it a possible remedy for filtering alkaline solutions, as in the preparation of boiler feed waters, because of the absence of silica.

Quality and Treatment—A voluminous report of the committee on quality and treatment (Paul Hansen, chairman) was ordered brought down to date and prepared for publication. This will be a comprehensive treatise on water purification condensed as a manual for operators. Already authorization has been given for publication of a history of water purification prepared by M. N. Baker, one member of Mr. Hansen's committee. It is planned to have this history appear early this winter, and the treatise will follow next spring.

Chemicals—M. C. Smith, Richmond, Va., reported on hazards to plant and personnel from the use of chlorine. Few, if any, deaths from chlorine have occurred, but several serious accidents have been experienced which the committee is analyzing. The trouble seems to be most serious in the connections between tank containers and the machines or header. Two suggestions were made: first, that the chlorine manufacturers improve the present valves; and, second, that the bureau of explosives of the Interstate Commerce Commission consider the elimination of fusible plugs or increase the temperature. The committee is of the opinion that much improvement can be made in header connections. Frequent careful inspection of the connections is recommended. Money is needed for research. It was recommended that the Bureau of Mines make tests of the two types of gas masks available. On first aid and subsequent treatment it was stated that Lieut. E. B. Vedder, of the Chemical Warfare Service, had prepared one of the best presentations, which it is hoped to make available for local physicians as well as operators.

Specifications for 27 chemicals used in water purification are well on the way toward publication. Matthew M. Braidech, reported that they would soon be published along with the research data on which they are based. Much of the test work was on activated carbon, since the criteria of useful factors are dependent upon local conditions and requirements.

Raw-Water Standards — H. W. Streeter, U. S. Public Health Service, discussed limiting working standards of bacterial quality for sources of water supply. Several states now have tentative standards based on the results of a survey made of seventeen purification plants on the Ohio, fourteen on the Great Lakes and five years' experiments at the PHS testing station at Cincinnati. In general, to produce a water that will conform to the Treasury B.-coli standards, Mr. Streeter stated the following as basic requirements:

The average B.-coli index of the raw water as delivered for treatment, when considered over a significantly long period of time, such as a year, should in no case exceed 5,000 per 100 cc., and the B.-coli index of such a water should not exceed 20,000 per 100 cc. during more than 5 per cent of the period considered, in which case the limiting average B.-coli index might be as high as, or something less than, 5,000 per 100 cc., according to the character of the source and variability of the water taken from that source.

Mine Wastes—Progress in abating mine-waste pollution of water supplies in the Ohio Valley has been accelerated by the use of relief workers and the activity of the several states affected. E. S. Tisdale, West Virginia state board of health, indicated that Pennsylvania, Ohio, West Virginia and Kentucky are operating on a uniform basis and are beginning to see decided results from the sealing off of air from abandoned mines. In his state 215 out of 766 abandoned mines have been sealed, reducing the acid content by 52 per cent. About $220,000 of relief funds has been spent.

F. W. Waring, Ohio state board of health, stated that in 1930 and 1934 acid had progressed down the Ohio below Marietta giving a pH content of 5.2. Most purification plants had to install lime equipment. Fifteen counties have spent $130,000 for labor in sealing operations, with an average cost per opening sealed of $63, ranging from $15 to $250. Some 4,000 have been closed in 15 months. About 20,000 are yet to be sealed, but the rate of closures now is 300 to 400 per month.

Pipe corrosion

W. W. Brush, in reporting on corrosion of pipe in buildings in New York since the introduction in 1917 of the soft Catskill water, indicated that failures in wrought-iron pipe were rare for sizes 2 in. and larger. For 1¼- to 2-in. sizes the pipe was good for 30 years, but for sizes smaller than 1¼ in. the effective life was 10 to 15 years. For steel pipes in the smaller sizes the experience was similar to wrought iron. No trouble has been experienced with brass pipes. An early failure was noted in a building equipped with common yellow brass pipes and supplied with well water in which CO_2 content was high. There are 50 different types of well water that are recognized in New York. The conclusion was voiced that materials should be selected only after the water content had been ascertained.

Experiments on the application of excess lime hydrate to Catskill water were outlined by F. E. Hale, who indicated that a moderate excess, 10 p.p.m., was desirable and reduced the corrosive effects materially. Greater excesses of lime were not so effective.

F. N. Speller in discussion stated that there was no panacea for corrosion. Excess lime helps, but one must know conditions. In New England, with soft water, cement-lined pipe has been successfully used for 50 years.

Coatings—Three methods of pipe coating to prevent corrosion and tuberculation were presented. A reconditioning process by the use of bituminous enamels after cleaning and drying was described in a paper by Linden Stuart, Wailes Dove-Hermiston Corp. For small pipes that cannot be entered, the pipe must be taken out, treated and relaid. For sizes 30 in. and more the pipes can be entered. Ventilation is essential. Sand blasting tried in New York was found expensive and troublesome. Scraping by hand and wire brushing appear to be the most practical procedure to remove the rust. Air tools are better than electric motors, which heat. Bulkheads are essential to prevent dust from carrying on to newly coated surfaces. Air-conditioning to prevent condensation may be necessary. Priming should be put on immediately after the surfaces have been cleaned and before moisture condenses and rusting starts.

Elson T. Killam described a cement-lining machine developed for use in large pipes. Essentially it throws cement mortar by centrifugal action onto the interior of the pipe, which is immediately smoothed by rotating trowels.

Thomas H. Wiggin went to Manchester, England, last year to observe the rehabilitation of small 4-, 5- and 6-in. pipe by the use of the Tate process invented in Australia. The pipes are first cleaned by a rotary blade cleaner, after which cement mortar is inserted followed by a mandril, which packs the mortar smoothly against the inside of the pipe. Services and connections have to be dug up and plugged. The mandril is pulled through by a hand-operated windlass at a rate of about 20 ft. per minute.

F. N. Speller, in discussion, said there was little hope for the discovery of any practical metal combinations that would be safe from corrosion for all conditions inside and outside. He would not recommend even stainless steel for some places. Treatment of the water is one answer. He thought cement linings for small pipes and bituminous coatings for larger sizes would be the general solution.

Cast-iron pipe report

Conclusions to date on the cast-iron pipe investigation were presented by Thomas H. Wiggin, consulting engineer, New York. Beginning in 1926, the investigation, sponsored by the A.W.W.A., the New England Water Works Association, the A.S.T.M. and the American Gas Association and supported by these organizations and the

manufacturers, has involved a new fundamental attack on the subject of cast-iron pipe. Extensive tests have been made. Although formal action has not been taken by the joint committee, the following decisions and accomplishments were listed:

1. Specifications for process and for metallurgical control in general are unwise. The committee has under consideration, however, recommendations of one of the subcommittees to place a limit of 0.10 per cent on sulphur and one of 0.90 per cent on phosphorus.
2. No practicable variations in iron mixtures will materially change or reduce the corrosion problem. Protective coatings must therefore be the main reliance, both outside and inside.
3. A tentative specification for cement lining for pipes has been issued; one for improved coal tar coating and for testing its efficiency has been developed; and another for refined tar enamel is under preliminary study.
4. Flow tests showing the loss of head in tees, crosses and bends 6 and 12 in. in diameter have been made. It is concluded that short fittings give no more total loss of head in distribution systems than do long fittings. A short body standard is therefore to be included at least in diameters of 12 in. and smaller. (In pumping stations where velocities are high, long-radius fittings were found desirable.)
5. From 200 bursting tests of 6- to 36-in. fittings, the design of fittings as regards strength will be put on a sounder basis.
6. From experiments made on pull-out strength of joints and on strength of bells against stresses caused by bending of joints, it has been concluded that there are no grounds for altering existing dimensions of bells. Bronze welded lugs, for holding harnesses, in cases where need of lugs or collars has not been foreseen when castings were made, have been tested and found practicable. Designs will be included.
7. Most important of all, bursting and crushing tests have been made on straight pipes of sizes 6, 12, 20 and 48 in., laid under various conditions as regards support and with and without tamping of backfilling. These tests, taken in connection with the results of years of testing of drain and culvert pipes at Iowa State College, have demonstrated to the committee that exterior or crushing load is generally an important part of the hazard to which pipe is subjected, and this hazard is often increased greatly by unfavorable methods of laying, as for example by use of block supports, particularly with blocks projecting above the bottom of the trench in the usual way, also by omission of tamping of backfill beneath and at the sides of the pipe.

A rational formula for computing thickness of pipe has been devised, and it is expected that the resulting thickness with some revisions in process will form the basis of the schedules to be recommended to the sponsors both for pit-cast and for special types of pipe.

The specifications are in part drafted, and it is hoped that a substantial part of them will be placed before the sponsor societies by this time next year, although there still remain in abeyance some important decisions regarding bell-and-spigot and flanged fittings.

Specifications

Negative reactions on standard gate-valve specifications were voiced by G. Gale Dixon, consulting engineer, Youngstown, in reporting progress on a subcommittee of the waterworks practice committee. The committee after three years of work on AWWA specifications, which are 25 to 30 years old, got out a new specification and sent it for critical comment to 100 users and manufacturers. The latter have just replied, essentially cutting out the new features, so that the old specifications would not be materially improved. No standard specification is in sight for many months.

A specification on riveted steel plate pipe is being prepared. The convention ordered publication of a tentative specification on laying cast-iron pipe. Also ordered published was a tentative specification for riveted steel tanks. Further research on welded tanks is to be undertaken.

California dams

Leslie W. Stocker, San Francisco, described the proposed enlarged O'Shaughnessy Dam, to increase the capacity by 75 per cent, from 67 to 117 billion gallons and from 220 ft. water depth to 306 ft. The problem is to tie the new work to the old so that the former will take its proper share of the load. The crest will be raised 85.5 ft. by the addition of 268,000 cu.yd. of concrete.

The Morris Dam was described by Samuel B. Morris, chief engineer Pasadena waterworks, for whom it was christened a year ago by ex-president Hoover (*ENR*, Dec. 27, 1934, p. 823).

The Bouquet Dam and inlet-outlet pipe were described by W. W. Hurlbut, engineer of waterworks, Los Angeles. The dam is an earthfill structure being built by the controlled compaction method (*ENR*, June 21, 1934, p. 810).

Finance and accounting

In the finance and accounting division papers covered the following subjects: collection procedure, water financial policy in Cincinnati, sales taxes, collection of statistics, relation of engineering and accounting to depreciation for rates and taxes, utility regulation, uniform classification of accounts and the special lien bond situation.

M. F. Hoffman described the Cincinnati method of staggered collections with a flexible three-part bill, eliminating the old cumbersome ledger. It has resulted in saving $125,000 a year.

Collection of national waterworks data has baffled the association for many years. National statistics are badly needed. Nathan B. Jacobs indicated in his paper on the subject that the problem is twofold: first, that of educating officials to the necessity and need of furnishing the data; and second, the cost of compilation and publication. An educational campaign by the division was recommended as well as development of a standard form. Employment of an engineering statistician to develop the data was suggested.

In a review of the special lien bond situation Robert A. Taft, attorney, stated that the earnings often made these bonds more desirable than general obligations. If they are self-supporting they should be excluded from debt limitations, but it is hard to determine whether such is the case. The objection is that the bonds represent 100 per cent of the cost of the plant, and therefore general bonds should be for 50 per cent of the cost and lien bonds for the difference. He recommended making them serial rather than of the sinking-fund type.

Letters to the Editor

Concrete in Sea Water

Sir—Your interesting article "Bituminized Concrete Casing for Piles in Sea Water" (*ENR*, Jan. 24, 1935, p. 121) refers in conclusion to the excellent condition of the asphalt-impregnated concrete piles in Los Angeles harbor that have been in service for over ten years, and closes with some words of an almost standardized nature regarding the effect of sea water on plain, untreated, unimpregnated concrete. Strangely missing were: ". . . the sulphates of magnesium in the sea water combine with the free lime of the cement to form calcium sulph . . .", etc.

The writer has the fullest confidence in the endurance of asphalt-impregnated concrete, in sea water or out of it. He also believes that it is possible with any cement to make such poor concrete that it will disintegrate in sea water or in fresh water.

However, as to his further belief regarding the behavior in sea water of plain, untreated, unprotected concrete of dense, impermeable and uniform structure, made of sound materials, the behavior of certain other Los Angeles har-

CONCRETE PILING IN LOS ANGELES HARBOR

(From "Chronological Development of Concrete Piling at Los Angeles Harbor, 1910–1933")

Job	Date Constructed	Type of Piling	Incipient Disintegration Noted	Complete Disintegration	Concrete Mix
Watchborn Basin.....	1910	Precast conc.	1918	1920	1–2–4
Bertha 51–55.....	1911	Precast conc.	1918	1920	1–2–4
Bertha 56–60.....	1913	Precast conc.	1926	Repaired 1927	1:1.33:3.66
Berth 187.....	1921	Hollow Gunite	....	....	1:3.50:0.00
Bertha 188–191.....	1923	Precast conc.	....	....	1:1.83:3.00
Bertha 174–178.....	1923	Asph.-impreg. conc.	....	....	1:3.00:3.00
Bertha 232 D. E.....	1923	Solid Gunite	....	....	1:3.50:0.00
Bertha 232 A. B.....	1923	A. I. conc.	....	....	1:3.50:3.50

Nine other jobs, 1924 to 1933, including Fish Harbor Mole, are reported. None have incipient disintegration.

bor concrete structures is relevant and pertinent.

The lighthouse at the extremity of the Los Angeles breakwater, constructed by the U. S. Engineer Corps, is built upon a large foundation block of concrete. On one side of this block are large numbers: 1910. It has been washed and wave-beaten with pure undiluted sea water for a quarter of a century. The corners are sharp-edged and there is no disintegration! Below high water it was made of a somewhat harsh, sea-water-gaged 1:2:4 mixture.

A few months ago the bascule bridge of the Union Pacific Railway across the entrance to the harbor at Cerritos Channel, known as the Seaside Bridge, was removed. It was built in 1908. It was only a few hundred feet from the open ocean, and its piers, clean except for barnacles, etc., had been in sea water for 26 years. It was made of a 1½:3:5 mixture. There was no trace of disintegration.

The Southern Pacific Railway has a bascule bridge across the entrance to the west basin of the inner Los Angeles harbor that was built in 1911. Its piers have been in sea water, therefore, for 24 years. They are pretty well coated with fuel oil, and the concrete surfaces cannot be seen. The corners and edges however, appear to be clean-lined and sharp. It can safely be said that no disintegration has occurred.

The Los Angeles Harbor Board has had some very costly and unfortunate experience with untreated concrete in sea water, chiefly with piles and with its earliest construction. An official report, of limited edition, covering the concrete pile work in the harbor from 1910 to 1933 was issued last year. This report declares strongly the need for protective treatments and endorses the asphalt-impregnation method.

However, the tabulated summary accompanying this report, abstracted herewith, shows the interesting fact that certain non-treated, non-impregnated concrete structures in Los Angeles harbor have likewise, *mirabile dictu*, "been in service . . . for more than ten years and . . . remain in excellent condition." Attention is directed to the fact that the table contains a column headed: "Incipient Disintegration Noted," with the opportunity thereby afforded of supplying a date when there was any disintegration to note.

In conclusion, the writer would restate his fullest confidence in the ability of asphalt-impregnated concrete to resist sea-water action. His confidence is no less in the ability of plain untreated concrete to do the same thing if made of sound materials and of an impermeable uniform structure. Both of the above statements are concerned with the point at issue: effects of sea water on *concrete*. Sea-water effects due to shape of specimen, joints, rusting of reinforcement, unsound materials, etc., are specifically excluded from consideration. It is the disintegration caused by "the disintegrating sea-water salts" on sound, dense concrete that the writer has been looking for quite earnestly for the past five years along the Pacific Coast, from Vancouver, B. C., to San Diego. After examining a very large number of structures, he has as yet found no evidence of it. A very few cases of early and bad disintegration have been observed, but these cases are so few and so abnormal that, regrettable as they are, they are most noteworthy as exceptions to the otherwise almost complete immunity to sea-water attack shown by concretes made in many different places, in many different years, with many different brands of cement.

HOMER M. HADLEY,
Regional Structural Engineer,
Portland Cement Association.
San Francisco, Calif.,
April 3, 1935.

Rigid Viaduct Bents

Sir—The article "A Rapid and Concise Method of Analyzing Rigid Viaduct Bents," by L. C. Maugh in your issue of March 14, 1935, presents an excellent method of analysis for one type of Vierendeel truss. I have used another method of successive approximations for rigid bents of this form which I believe may be of interest to others.

Consider half of a typical panel, with the forces acting on it as shown in Fig. 1. Since the bent is symmetrical about a vertical center line, there will be a point of contraflexure at the midpoint of each strut. The problem is completely solved when the k values are determined. It can be proved by the standard methods of elastic analysis (neglecting deflections due to direct stress) that:

$$k_a = C_1 N_b - C_2 N_a - C_3 V - C_4 M_b$$

in which V is the external shear for panel ab. The values of the coefficients in the above formula depend upon the dimensions of the bent and are computed from the following relations:

$$C_1 = \frac{1}{D}\left[H_b^3 \frac{I_c}{I_b} + 3S H_b (H_b + H_a) \right]$$

$$C_2 = \frac{1}{D}\left[H_b^3 \frac{I_c}{I_b} + 2S (H_b^2 + H_b H_a + H_a^2) \right]$$

$$C_3 = \frac{1}{D}\left[SL (H_b + 2H_a) \right]$$

$$C_4 = \frac{1}{D}\left[6S (H_b + H_a) \right]$$

$$D = H_b^3 \frac{I_c}{I_b} + H_a^3 \frac{I_c}{I_a} + 2S (H_b^2 + H_b H_a + H_a^2)$$

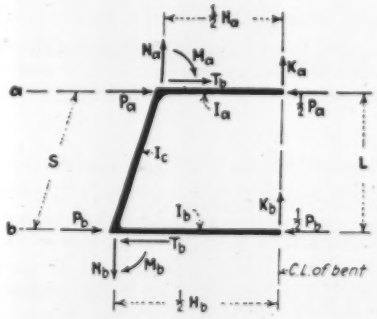
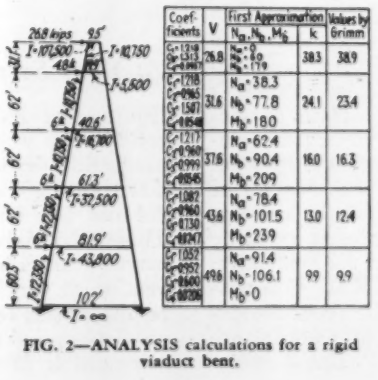


FIG. 1—FORCES on typical panel of a rigid viaduct bent.



Coefficients	V	First Approximation Na, Nb, Mb	k	Values by Grimm
Cr=1316 Cp=1313 C=1947	26.8	Na=0 Nb=149 Mb=179	38.3	38.9
Cr=1218 Cp=0965 Cp=1567 C=1854	31.6	Na=38.3 Nb=77.8 Mb=180	24.1	23.4
Cr=1217 Cp=0960 Cp=0999 C=1856	37.6	Na=62.4 Nb=90.4 Mb=209	16.0	16.3
Cr=1087 Cp=0960 Cp=1730 C=1820	43.6	Na=78.4 Nb=101.5 Mb=239	13.0	12.4
Cr=1052 Cp=0952 C=1800	49.6	Na=91.4 Nb=106.1 Mb=0	9.9	9.9

FIG. 2—ANALYSIS calculations for a rigid viaduct bent.

The method of solution, using this formula, is as follows:

1. Evaluate the coefficients in the formula for each panel.

2. Start with the top panel. By assuming the location of the points of contraflexure for the posts in the second panel at the mid-height of the posts, values for N_b and M_b may be computed. V is known from the loading, and N_a is zero. Substituting these values in the formula gives a direct solution for $k_a = k_1$.

3. Consider the second panel. N_a for this panel equals k_1, which was calculated in step 2. By assuming points of contraflexure at the mid-height of the posts in the third panel, values for N_b and M_b may be calculated. These quantities may then be substituted in the formula to give a direct solution for $k_a = k_2$.

4. Proceed in a similar manner for each panel in succession.

In general, the k values so found will be accurate enough for design purposes. If greater accuracy is desired, the whole procedure may be repeated, using the values obtained in the first series of computations to calculate N_b and M_b for each panel.

The application of this method to the Kinzua viaduct bent, which Prof. Maugh used as an example, is shown in Fig. 2. It is seen that the values obtained in the first approximation are close enough to Grimm's values for all practical purposes.

DANA YOUNG,
Assistant Professor of Engineering,
Connecticut State College.
Storrs, Conn.,
March 17, 1935.

ENGINEERING NEWS-RECORD

Volume 114, No. 20

Copyright 1935 by McGraw-Hill Publishing Company, Inc.

EDITOR—F. E. Schmitt. EDITORIAL STAFF—V. T. Boughton, N. A. Bowers, W. G. Bowman, W. W. DeBerard, C. S. Hill, H. W. Richardson

Editorial and Publishing Offices at 330 West 42d Street, New York

May 16, 1935

The Paint Didn't Hold!

THE TOWER of an elevated water tank for a small town in Alabama collapsed a few weeks ago as the tank was being filled for the first time. The whole structure was a makeshift supplied, it is reported, by a dealer in second-hand material. The tank was made by inverting the domed top of an old stove of a blast furnace, and the tower legs were compression members from an old bridge, crudely spliced with bolted plates, the bolt holes being burned through the plates with a torch—and the whole was nicely painted with bright paint to make a workmanlike job! A lot of negroes were frightened when the tank fell, but no one was killed; hence it may be expected that the lesson that the collapse ought to have taught will be forgotten and that Alabama must wait for a real disaster before placing a check on those who would design structures involving public safety. Alabama as yet has no law requiring those who design structures to demonstrate that they are competent to do so, although the passage of one has been proposed by engineers of the state. License laws are no guarantee against defective structural design, but they are a definite check upon it, and in cases of structural failures they make it possible to institute civil suit—an action that is bound to have a salutary effect on dealers in building materials or small builders who offer to furnish their own designs, with little thought of adequate engineering responsibility and often expecting the paint to hold the structure together.

Experience Gives Counsel

IN NO RESPECT, perhaps, were the conclusions reached by the Chamber of Commerce of the United States a week ago more truly expressive of practical business experience than in the recommendations on the NRA and the code system. These recommendations took due account of the judicial finding that federal control of business is unlawful when it goes beyond the scope of regulation of commerce between the states. In doing so they not only expressed the opposition of most citizens to the breaking down of our tried system of government but also gave voice to experience in the practical conduct of daily affairs, an experience which does not endorse the attempt to center the management of a nation in Washington, and still less endorses the farming out of functions of government. The Chamber's recommendations were for voluntary in place of dictated or imposed codes—the latter particularly incompatible with the ideal of industrial self-government. With respect to the interpretation and adjudication of fair-practice rules, the Chamber held that the existing mechanism of the Federal Trade Commission aided by court process should be used—in place of the ineffective, duplicating attempt at enforcement by NRA. It is possible that these and other elements of the recommendations were inspired more by the needs of manufacture and trade than by those of construction. But if industry in general finds such reform of the code system essential and helpful, construction unquestionably will adapt itself to the change.

Decentralizing Self-Government

WHETHER under the present code system or a successor, the decentralization of industrial self-government proposed by the Construction Code Authority, as outlined on page 711 of this issue, represents a major contribution to development of sound business procedure. It promises to accomplish two results of utmost value: reduction in the confused multiplicity of code administering agencies, and enlistment of local knowledge and judgment in the consideration of fair-practice problems. The latter is perhaps the more significant item of gain, for without active local participation it is hardly possible to establish a stable self-government system. An initial step toward putting the proposal into practice, the creation of joint bid depositories, has already been taken in a number of cities. It is to be hoped that the local code council system will also soon be tried out in a sufficient number of centers to give it a conclusive test. The greatest item of salvage that we are likely to realize from the past year of code labors in the construction field is the practical consciousness that the several branches of the industry have a vital community of interest.

Smoke Out the Conclusions

A CHANGE from the policy of publishing only complete and final reports of research studies, or issuing "best-practice" rules only when unanimous agreement has been achieved, was noted on the part of the American Water Works Association at its convention last week. Activation of committees that have been studying specific subjects for several years to embody their findings in tentative specifications seems to indicate that the association recognizes its responsibility. The presentation of preliminary conclusions from the cast-iron pipe investigation was another significant occurrence. It is a change in the right direction. To hold subjects in committee for complete incubation often thwarts progress and delays necessary standardization. Slowness in getting tentative best-practice rules or specifications into circulation tends to check the growth of better practice. Gate valve, meter and hydrant specifications are thirty years old, and in view of the research that has been carried on in the meantime it is inconceivable that they represent practice adequately. If the association will foster the trend now begun toward early publication of at least tentative specifications, it can become a much greater force for progress and stabilization than it ever has been before.

At Your Service

EQUIPMENT AND MATERIALS in the engineering and construction world are in constant change. Though the production departments of many manufacturers slowed down during the depression, development and research did not lag, but were accelerated in many instances. Those who visited the instructive exhibit of waterworks manufacturers held in connection with the AWWA convention at Cincinnati last week were impressed by the results of this research. Several wholly new items were on display, and many an old familiar article was hardly recognizable in new and improved form. Correspond-

ing improvement marks the field of construction equipment. Old relics from the boom days are being replaced by modern, more efficient and versatile pieces of equipment. Never before has the user of engineering and construction equipment and materials had such a wealth of mechanical aid at his disposal.

Soil Knowledge in Practice

THIS WEEK'S ACCOUNT of soil-survey practice by the New Hampshire highway department directs merited attention to the soil-classification work of the Bureau of Public Roads. Of all the diligent research labor that this active federal bureau has contributed to the service of roadbuilding none has called for more persistent courage. At the beginning, which in America was barely a decade ago, soil physics for the engineer was veiled in an abstruseness that roused the derision of roadbuilders. In the face of this skepticism as well as the inherent difficulties of the subject, experimentation was begun by the bureau's engineers, who perceived the kernel of worth within the husk of too-refined science. Years were required before research pointed to a definite classification of soils that could have meaning to practical roadbuilders, and then their indifference began to give way. Today, in the bureau classification of soils and in the testing technique developed for their identification the roadbuilder has a tool for rational road foundation design that he is putting to sound use, as in New Hampshire.

An Important Partner

IF THERE HAS BEEN any doubt about the fact that citizen, industry and government are close partners in the upward pull toward recovery, that doubt has been thoroughly dispelled. Everyone knows by now that the national administration cannot do it all, and that even so huge a sum as four billion dollars is puny compared with the task to be performed. Certain of the obligations imposed by this partnership claim present consideration.

The decisive share in the joint undertaking, of course, is that of private enterprise. The powers of government, on the other hand, are concerned primarily with preparing conditions such that the resumption of business activity will be facilitated. In carrying out this function the city is an important partner, indeed the principal partner. Measured by business volume it is ten times as large a factor in the life of both industry and construction as the federal government.

One of the most gratifying developments of the day is the practical recognition now being given to this partnership of the states and cities with the national government. During the works campaign under the 1933 Recovery Act, the function of the city was but grudgingly and ineffectively acknowledged, and because of this the campaign was seriously weakened. Today, on the contrary, the cities have been accorded representation on the Works Allotment Board for the relief-works program. And what is even more encouraging, their organized public-works engineers have taken up earnest study of the problems of the new campaign. A series of recommendations which these men drafted at Washington last week to assist the campaign constitutes a constructive contribution to its efficient management.

It is well that there be clear understanding of the importance of this intergovernmental cooperation. It lies in both the character of local improvements and their readiness for immediate construction. City and state projects are the most valuable part of any works program because they represent actual necessities of community service and are a part of the regular business of carrying on our daily life. They have nothing of the speculative or fanciful; they are not risky or unremunerative ventures built on hopes for future social betterment, as are some of the hastily conceived federal schemes. They pay their way, moreover. These are reasons that make them the most essential part of a useful works program.

It is important further to appreciate the nature of this governmental partnership. It is not a partnership in spending. Quite the contrary, it is constructive cooperation in carrying out work that is an intimate part of the country's regular activities, with the purpose of restoring the normal course of industrial and social progress. Through its very spirit this cooperation implies, incidentally, a sharing of financial burdens, a readiness on the part of states and cities to draw to fullest extent on their own resources in furtherance of the joint effort.

The recommendations of the public-works engineers with respect to the new campaign are in the main excellent doctrine. Though seriously weakened by an untimely and unwarranted plea of destitution, they merit an attentive hearing. But they must be followed up and developed into continuous, aggressive cooperation with the federal authorities, to the end that the relief-works campaign may be made a full success.

It is time that the cities reasserted themselves as independent, virile units of the national organism, rather than that voluntarily they should do what so many unfortunate individuals are forced to do—go on the dole. In this return to normal ways of life the public-works engineers can, if they will, take the lead. By so doing, they will give double aid to recovery.

Courage Needed

THE BRIEFNESS with which the report of the Maryland State Planning Commission on a ten-year highway improvement plan is summarized should not be allowed to obscure a real event in highway development. As the first announced result of authorized long-time programming of state-wide road improvement the report marks an epoch.

This being so, advocates of comprehensive public-roads service could well wish that it had set bolder standards as an example and criterion. As was stated in these columns three weeks ago, a strong and confident attitude is required toward road-system planning by highway engineers. Now as never before they need to assert independence of the temporizing policies of the past. Their obligation is no longer that of lifting traffic out of the mud; they have to create a highway transportation system. The Maryland planning commission fully grasps this obligation, but it might well have carried it to bolder conclusions in respect to design details.

It is true enough that with present limits of knowledge there is risk in fixing standards too far ahead. Yet there are certain factors of width, traffic capacity, alignment and sight distance that can now be defined with reasonable certainty. If it takes courage to define them, that courage is in order when programs are formulated as a basis for future development.

CURRENT NEWS

Rules For Filing Relief Works Projects Are Announced

(Washington Correspondence)

WASHINGTON, May 13—The government's relief works program moved slowly into action this week with the announcement of rules for the filing and routing of applications for allotments from the $4,000,000,000 fund. It was also expected that the initial allotments to the states for road construction would be made before the end of the week. Wage and hour requirements remain to be determined, however. Also the conditions under which the government will utilize the services of contractors.

Much confusion was eliminated by the announcement that all proposals for local relief projects to be financed entirely by the federal government should be filed with local or state administrators of the Works Progress Administration, and that non-federal projects, financed by loan or grant, or both, should be filed, as heretofore, with PWA state engineers. Applications now pending in PWA, whether federal or non-federal, need not be resubmitted.

Delay will be avoided by having all projects studied by PWA, in the case of non-federal projects, and by federal agencies, in the case of federal projects initiated or suggested to them, before being forwarded to the Division of Applications and Information.

All projects will be reviewed by the DAI to determine whether they conform to the fundamental principles of the relief works program, as outlined by President Roosevelt, that a project shall be useful and that a considerable proportion of the money spent shall go into wages.

The final test of eligibility, however, will be the recommendation of the Works Progress Division, to which all applications will be referred, that the project will be an effective means of creating employment in the area in which it is located. This procedure places Harry Hopkins in a position subordinate only to the President. To expedite selection of projects the country has been divided into 320 districts, more or less, in which FERA has tabulated the number on relief rolls, the number which are employable and their normal occupations.

Further labor requirements contemplated

Because of the limitations of the relief works program in affording employment for the vast variety of trades which are embodied by relief labor, consideration is being given to imposing a requirement that private industries draw from relief rolls any additional labor needed to fill government orders for materials and equipment. The implication is inescapable that the orders will go to the firms which can make the best showing in expanding their payrolls. Such a policy is expected to arouse protest as it has been generally

(Continued on p. 722)

Bids to Be Received on Buzzards Roost Project

Bids will be taken May 27 by Greenwood County, S. C., for the Buzzards Roost power project on the Saluda River. It was erroneously reported in our May 2 issue (p. 650) that the federal district court at Greenville had granted the Duke Power Co. an injunction against the project, which is to be built with PWA funds. While the decision was adverse and to the effect that it was unconstitutional to use PWA funds to build a public plant to sell power to private interests, it is believed by sponsors of the project that the opinion may be altered by testimony before a referee who has been appointed by the federal court. On this supposition they are proceeding to receive bids.

Bill Proposed in Senate To Authorize Parker Dam

WASHINGTON, May 13—Senator Johnson introduced, today, a bill to remedy the defect exposed by the Supreme Court's decision in the Parker Dam case by authorizing Parker, Grand Coulee and other projects which may be held to be on navigable streams financed by PWA allotments. The bill also validates and ratifies all contracts heretofore executed and authorizes the President to construct, maintain and operate such dams and incidental works and enter into any further contracts that may be necessary including contracts amendatory or supplementary to contracts validated.

Hackett Becomes Assistant PWA Administrator

Horatio B. Hackett, former director of the housing division of the PWA, has been advanced to the position of Assistant Administrator of Public Works. Mr. Hackett will succeed Maj. Philip B. Fleming, who will return to the Corps of Engineers. Angelo R. Clas, who has been assistant to Mr. Hackett, becomes director of the housing division.

Revised San Gabriel Design Disapproved by Authorities

LOS ANGELES, May 13—The revised plans for San Gabriel Dam No. 1 were disapproved on May 10 by State Engineer Hyatt and U. S. Forest Service engineers on the grounds that the mixed material proposed to be used is inadequate for stability. The action is based on a report of a special consulting board consisting of C. D. Marx, W. L. Huber and F. C. Hermann. The County Board of Supervisors today began efforts to obtain reconsideration of the disapproval, in conference with Chief Engineer C. H. Howell and the consulting boards.

The supervisors declare that the county is unable to return to the original design for the dam in view of the inadequacy of its available fund to provide the size and quality of rock required by the original specifications.

Cave-in Halts Abutment Work At Norris Dam

NORRIS, TENN., May 13.—A small slide or cave-in occurred May 5 under the upstream end of the cableway head-tower trestle at Norris Dam. The following statement of facts is given by Ross White, who is construction superintendent of the dam.

Work had been in progress for some time in cleaning out mud and débris from a cave in the limestone of the west abutment, preparatory to plugging with concrete, 180 ft. below the track level. At the extreme point reached, directly under the cableway track, a chimney led upward from this cave. Considerable earth and mud flowed down into the cave from this chimney, but it was not thought likely that any caving would reach the surface. The heavy rains of the past few weeks had evidently softened the clay, however, and the soil continued caving until the surface settled. The movement at the surface was detected almost as soon as it started, and the head towers were moved off the endangered area.

One person was injured in the accident; the property damage is small. All of the head-tower track except the extreme ends is founded on rock. Core borings show that solid rock lies 20 to 40 ft. below the surface at this point except for the funnel-shaped depression which leads to the cave below. This surface soil is being stripped off by dragline and the trestle footing carried to rock, with the opening bridged by a heavy concrete beam.

Work on west end slowed up

Concrete placing on and near the west abutment will be interrupted for two to three weeks. By skewing the towers the power house and eastern half of the dam can be reached, however, and work there has not been interrupted. Top of solid dolomite rock is about 80 ft. above the top of the dam. By plugging the top of the chimney with concrete the cleanout operations below can be continued and the abutment sealed against the escape of stored water.

Concrete placing on the dam is more than three months ahead of schedule, and the caving will cause no appreciable change in the construction program, which calls for the completion of Norris Dam early in 1936.

Cement Gun Contractors Code Has Its Name Changed

An amendment to the cement gun contractors' code to change the name of the code has been approved by the NIRB. Because the term "Cement Gun" is a proprietary name all members of the industry could not use it, and the amendment fixes the name of "Air Applied Concrete Contracting Industry" as the official name of this division of the construction industry.

State PWA Offices To Study Projects Under New Plan

WASHINGTON, May 14.—Final plans for decentralization of PWA under the new program were completed this week when Administrator Ickes approved the setting up in each state of miniature PWA offices with a director and a complete staff. The Administrator ordered that transfer of lawyers, engineers and finance examiners, as well as a number of trained stenographers and clerks to the state headquarters be accomplished as quickly as possible. Selection of the directors for the various state headquarters will be announced in a few days. In some cases the state engineer will be named director, but in other states, where the volume of work is great, the director will be added to the staff.

The final lists of attorneys, engineers and finance men, with their new assignments, are also expected to be approved shortly. Tentative arrangements call for the transfer from Washington to the states of about 100 lawyers, 50 engineers and 25 finance examiners.

Most of these men have had two years of experience with PWA problems in Washington and will establish themselves in present PWA state headquarters, now occupied only by a state engineer. An effort is being made to send them to states where they are especially familiar with local laws and conditions. As 25 PWA attorneys are already in the field, the lawyers sent from Washington will bring the legal field force to approximately 125 men. The number of lawyers transferred to the various state headquarters will vary in proportion to the non-federal applications.

The same difference in size will be followed by the other sections of the state staffs, but every PWA headquarters will be a complete unit with an engineer to determine the feasibility of applications, a lawyer to examine their legality, and a finance examiner to pass upon their financial soundness. The main effect of decentralization will be the removal of the congestion caused in Washington by thousands of applications for loans and grants descending upon PWA headquarters. Under the new system, the state headquarters will receive and examine applications and make their recommendations to Washington. Applications will be given a final check in Washington before being handed on to the Division of Applications and Information, and from there to the advisory committee on allotments.

Federal Housing Land Purchase Speeded in Two Cities

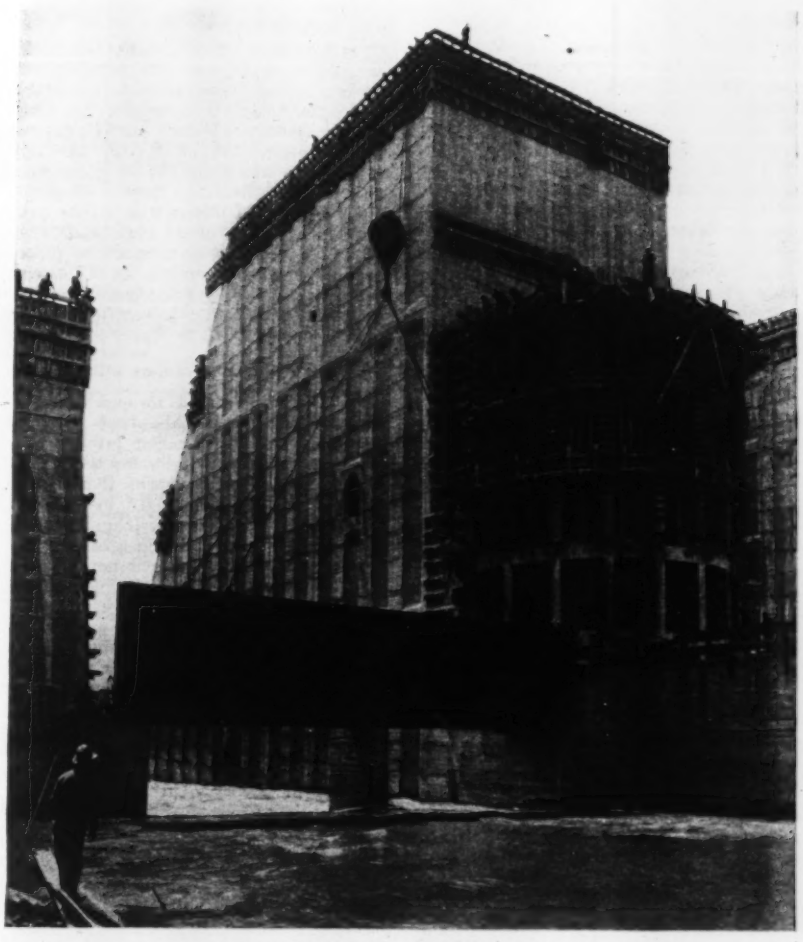
Two new developments in methods of acquiring slum sites for PWA large scale housing projects were recorded during the week in New York and Nashville. Upon assurance from Mayor LaGuardia that New York City within ten days could acquire land for the remainder of the Williamsburg slum-clearance project, in Brooklyn, Administrator Ickes authorized, May 14, the withdrawal of federal condemnation on the unacquired portion of the site. The city is to bring condemnation action, to acquire good title to the land and convey it within 30 days to the United States. The purchase price to the federal government is to be that awarded to the property owners in the condemnation proceedings, provided that this does not substantially exceed the government's appraisals. The change in procedure is expected to speed development of the project.

Details of the slum-clearance and low-rent housing project for Nashville were announced this week by Administrator Ickes. The project, for which PWA made an allotment of $990,000, will provide 276 dwellings in one- and two-story row houses. Assembly of the site was made possible by direct purchase from property owners. This is the first instance in which a site with scattered ownership has been totally assembled through direct purchase and without condemnation. Notices that options taken by the federal government will be accepted have been sent to Nashville property owners.

Boardman Appointed Director of New York City Relief Work

NEW YORK, May 10—The appointment of Francis Boardman, as successor to Col. William J. Wilgus, to the directorship of the New York City Emergency Relief Bureau, has been announced by Oswald W. Knauth, executive director of the bureau.

Mr. Boardman, a graduate of Yale in 1897, took post-graduate work at the Columbia School of Mines and joined the New York Central R.R. in 1902. After filling minor positions he was successively assistant engineer, roadmaster, designing engineer and division engineer of the New York division. He was in charge of maintenance and construction during the change from steam to electric operation and was then appointed engineer for terminal management at Grand Central Terminal. At present Mr. Boardman is assistant terminal manager for the railroad at Grand Central Terminal but has been granted a leave of absence to assume his new duties.



PLACING GATE BETWEEN SECTIONS OF NORRIS DAM

Fifteen-ton steel gate being lowered into place between two sections of Norris Dam on the Clinch River. Placement of this 11x60 ft. bulkhead forced the river to flow through two similar gaps still open in midstream, and caused a rise of 5 ft. in the water above the dam. Concrete is now being poured in the section protected by the gate, to bring it to a level with other sections of the structure. The steel gate will be used later on the remaining two openings in the dam when those sections are built up alternately 5 ft. at a time. This alternating of the steel gate from one midstream gap to the other after every 5 ft. of concrete will continue until the lake forming above the dam reaches the level of the flood-control sluiceways which penetrate the base of the dam. Norris Dam is being built by the Tennessee Valley Authority.

Reclamation Bureau Work to Center In Washington

Under a rearrangement of the U. S. Bureau of Reclamation's organization, control of project operation will be shifted from the Denver to the Washington office of the Bureau. An order of Dr. Elwood Mead, Commissioner of Reclamation, made public last week, directs that effective July 1 the superintendents of operating projects are to report to Washington. George O. Sanford, head of the engineering division of the Bureau in the Washington office, has been named in general charge of operation and maintenance. Mr. Sanford is to spend much time in the field conferring with superintendents.

Five operating districts have been created to promote efficiency and further unify operating policies, and a district supervisor has been named for each, as follows: Montana, H. H. Johnson; Idaho, Washington and Oregon, including Klamath project, John S. Moore; Wyoming, South Dakota, Nebraska, H. D. Comstock; northern California, northern Nevada, Utah, Colorado, L. H. Mitchell; southern California, southern Nevada, Arizona, New Mexico, R. C. E. Weber. Several of these district supervisors are project superintendents, and will continue in this position, with suitable assistance.

Operating supervision is expected to give particular attention to problems connected with water supply, storage and delivery; improvement of irrigation methods; study of seepage; status of temporarily unproductive lands and of excess holdings; improvements in crop census; and promotion of general project welfare. The district conferences are planned to bring together the operating problems and experiences of the projects operated by water users' associations as well as of those operated by the Bureau direct.

Proposed Mississippi Bridge Subject of St. Louis Hearing

The application for a permit to construct a highway toll bridge across the Mississippi River between St. Louis, Mo., and the town of Stites, Ill., will be the subject of a hearing to be held in St. Louis, May 20. The application is being made by the board of supervisors for St. Clair County, Ill.

The preliminary sketches for the proposed bridge have been prepared by the superintendent of highways for St. Clair County. The county proposes to seek a PWA grant and loan of $2,750,000 to finance the project. It will be of reinforced concrete and steel construction. Plans are for the bridge to be self-liquidating. Receipts from tolls above operating and maintenance expenses are to be used to pay off bonds.

The bridge would consist of five truss spans totaling 2,312 ft. in length with approach spans on both the Illinois and Missouri ends. Three channel spans each with piers 544 ft. center to center are to provide horizontal clearances of not less than 522 ft. each. There will be a vertical clearance of not less than 55 ft. above extreme high water.

Rules For Relief Works Projects

(Continued from p. 720)

assumed that the hiring of relief labor would be confined to direct employment on the project and that the indirect employment created would be open to idle labor, which may or may not be on relief. This furnishes another inducement to idle workers still subsisting on their own resources to go on relief.

Regional wages to vary

Security payments will, according to present plans, vary regionally from $20 to $100 a month, and the work week will be cut short in order to distribute the money among as many workers as possible. This will also reconcile organized labor to rejection of its demand of payment of prevailing wage rates. It is expected that only one person per family will be drawn from relief rolls and that subsistence requirements will be ignored. This means that if the security wage paid by the federal government is not sufficient to meet a family's needs the states and local communities will be required to supplement it with direct relief.

Segregation by the Advisory Committee on Allotments of half the amounts earmarked by the law for highways, rural rehabilitation, etc., is significant, according to Administrator Ickes, only because it confines application of the 20 per cent tolerance by which the President can raise or lower the allocations to the remaining $2,000,000,000. It doesn't mean, he said, that PWA can go ahead and spend $450,000,000, as each project must be passed by the Advisory Committee on Allotments and approved by the President. It simply means that PWA can present projects up to that amount.

Old PWA applications utilized

PWA has presented through the Advisory Committee on Allotments some of the $100,000,000 in pending projects prepared for allotment prior to the appropriation of the relief works fund. Most of them will be constructed by contract, according to Administrator Ickes, but force account will be used to the greatest practicable extent. Mr. Ickes is not in favor of 100 per cent grants on non-federal projects, neither does he believe that relief works funds should be turned over to the municipalities for spending as they see fit. "It is one thing to hand over money to an honest, efficient administration, but then what do you say to cities which have a corrupt and inefficient government?" he asked. "We have to look at this from a broad national point of view in order to conserve the money. On non-federal projects we let them run their own work. We do put on inspectors to see that contracts are lived up to, but we do not interfere unless something goes wrong. It doesn't slow up work one particle. The difficulty is more fancied than real."

Grade crossing decision up to MacDonald

The Advisory Committee on Allotments, which held its first meeting on May 7, is scheduled to meet again May 16. President Roosevelt will leave to Thomas H. MacDonald, chief of the Bureau of Public Roads, the decision whether it is desirable to create a new division in that bureau to supervise the grade-crossing elimination program.

Washington Highlights

By PAUL WOOTON
Washington Correspondent, Engineering News-Record

WASHINGTON, May 14—Administration leaders are doing their best to defer general tax legislation until 1937, after election.

Amendments to the banking bill in the House liberate state banks from the real estate restrictions of Federal Reserve regulations. Reserve Board officials say this is unsound, but admit it means more loans for construction.

Washington is watching with mixed feeling the ground being gained by inflation psychology.

Of the nine regular appropriation bills, Independent Offices, State, Justice, Commerce and Labor, War and Interior, have become laws. The Treasury and Post Office bills probably will be signed before this appears in print. Agricultural appropriations, after long controversy, are about to be approved. The Navy bill has yet to pass the Senate, while the Legislative bill is only started on its course through Congress. One deficiency bill has become a law; there will be two others. The District of Columbia bill is still in conference.

The Work Relief bill is the only major administration measure that has reached the statute books. Home Mortgage Relief, Social Security, the Banking bill, the NRA bill, Emergency Transportation and War Profits are among the important measures still pending.

Significant actions on NRA and TVA were taken by the Senate on May 14. A resolution was passed that provides for extending NRA only to April 1, 1936; the President had asked for a two-year extension. A bill by Senator Norris amending the TVA legislation so that it would meet Judge Grubb's decision that the TVA exceeded its rights in marketing electricity was also passed.

Famous Road Reproductions To Be at Pacific Exposition

Famous highways of the world will be reproduced by the Ford Motor Co., at the California-Pacific International Exposition at San Diego. The total length of the 12-ft. road will be 2,744 ft., and it will be composed of fourteen sections 196 ft. long. Each section will represent some famous road.

Representatives of the Ford Company selected the most famous highways from various countries, and then chose a section which was photographed and carefully described. The aim is to reproduce the road as truly as possible to the original and still enable the motorist to ride over it without undue discomfort.

The specifications are general in character, dependence being placed on the photographs and general descriptions. Among the roads which are being reproduced are: El Camino Real; Summer Palace Road (Chinese); Santa Fe Trail; Gold Road (Panama); Inca Highway (South America).

Rural Electrification Administration Is Set Up

Establishment of the Rural Electrification Administration was effected by an executive order dated May 11. The order does not name an administrator, but outlines duties and functions as being to "initiate, formulate, administer, and supervise a program of approved projects with respect to the generation, transmission, and distribution of electric energy in rural areas." The order also empowers the Administration to acquire land and provides that, in so far as is practicable, persons employed by the Rural Electrification Administration be taken from relief rolls.

Army Engineers to Survey Spokane Flood Project

The U. S. Senate has passed a bill autorizing army engineers to make a preliminary survey of the Spokane River in Washington and its tributaries in Idaho with a view toward developing a plan for flood control.

The survey has been ordered with the objective of preventing a repetition of the floods that occurred in December, 1933, when the Coeur d'Alenes and St. Joe River valleys were deeply inundated and heavy property damages resulted. Spokane also was flooded in many places by the high water from the river.

The Men Behind the Money

Washington Correspondence

IN THE new relief works program, as in the federally aided and administered work of last year, Hopkins, Ickes, Walker and Tugwell will get the headlines, while a group of "second string" men will put the $4,000,000,000 to work. Most of them have been on the job for a couple of years in PWA, FERA and other government agencies that will carry the new relief works load. Here are thumb-nail sketches of a few:

Jacob Baker, assistant administrator of the work division of FERA, was raised on a Colorado ranch, and sandwiched in work as a common laborer, miner and surveyor between jobs on the Pacific Coast as personnel manager for Bethlehem Shipbuilding Corp., Associated Oil Co., San Joaquin Light & Power Corp. Later he went East as a member of Houser, Baker & Associates, industrial engineers of Chicago, then on to New York as managing director of the Vanguard Press. Brusque but urbane, Baker is a direct-action man with fertile ideas effectively applied in stimulating work-relief projects. He goes hatless, smokes a big pipe and marches when he walks.

Aubrey Williams, assistant administrator of FERA in charge of state relations, is at his best when talking long distance with field men, state relief administrators and governors. As a hat salesman in Birmingham, night school and home study took him to Marysville College in Tennessee, where as a sophomore he headed a drive to raise $100,000 for his alma mater. Thence to the University of Cincinnati, to Europe for the YMCA, and a degree in philosophy from the University of Bordeaux. He developed his bent for social service as head of Cincinnati's community service and in Wisconsin as director of state conference of social work. Ten years later Hopkins found him organizing the relief program in Mississippi and put him in charge of the southern region.

Corrington Gill, FERA's assistant administrator, is a statistician who will spread his research work to include the relief works program. Lawrence Westbrook, assistant administrator No. 4, developed FERA's rural rehabilitation program that will expand under Tugwell's direction as Resettlement Administrator.

Fred Schnepfe is secretary of the Advisory Committee on Allotments, having been head of the PWA projects division. Quiet, serene, Schnepfe is an engineer who knows all the construction agencies of the federal government inside out and their work schedules for several years ahead.

Bugaboo in the early days of PWA three years ago, the slum clearance, low-rent housing program has been showing more speed since Horatio B. Hackett took over the job as director in February, 1934. Last week he was appointed assistant PWA administrator, relieving Major Philip B. Fleming who returns to the Corps of Engineers. All-American halfback at West Point in 1904, Hackett is widely known as a football referee. He doesn't believe in centralization in Washington. For his housing work plans for one project may be spread among a dozen architectural firms which pool their personnel for the job. The personnel and labor needed at every stage of the project are taken from the city for which the PWA Housing Division does the work. Col. Hackett came to PWA from the Chicago architectural firm of Holabird & Root.

Hugh H. Bennett is the original erosion control man. In the Bureau of Chemistry and Soils of the Department of Agriculture, Bennett developed a national plan for measuring the destructive effects of wind and water under varying conditions of soil, slope and climate, and worked up technical methods of control. Bennett is a showman. The dust storms that have billowed cross-country this year and last have been his billboards. Ickes gave him his own bureau in October, 1933 and $20 millions to spend on extensive demonstration projects covering 30 million acres. Bennett's Soil Erosion Service was recently transferred as a unit of Tugwell's Resettlement Administration. Control of soil erosion is one of the principal features of the work relief program. More than 500 of the 2,900 CCC camps will be located in areas where such control will be undertaken.

CCC Camps to be Used For Soil Erosion Work

A fight against soil erosion will be carried on this summer by 10,000 men operating out of 505 CCC camps. The work will be done under the general supervision of the Soil Erosion Service of the Department of Agriculture.

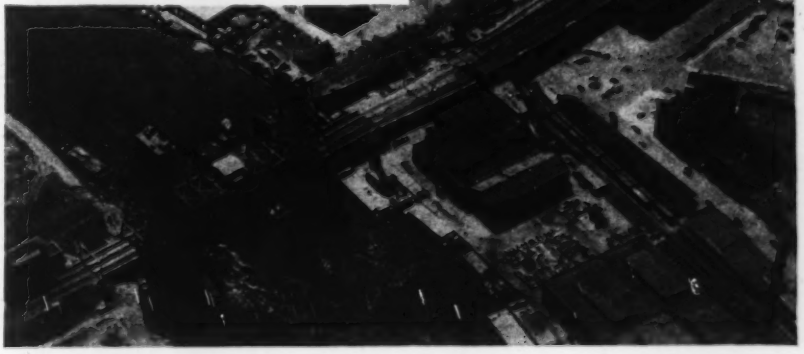
The program is designed especially to combat drought damage in the Middle West. About one-fourth of the camps will be established in the seven states where the dust storms have caused so much damage and the rest will be scattered throughout the country where soil erosion by water is a particularly important agricultural problem. In the acute wind erosion section, including all or parts of the Dakotas, Colorado, Kansas, Texas, Oklahoma and New Mexico, 123 camps will be established.

OLD STRUCTURES GIVE WAY TO NEW AT NEWARK TERMINAL

With its extensive new passenger-terminal facilities at Newark, N. J., in daily operation, the Pennsylvania Railroad is demolishing the old station and its approaches (shown beyond the new station and train-shed structure), to make way for additional tracks, to carry the Hudson & Manhattan R.R. (Hudson Tube) trains into the new station. These added tracks will cross the Passaic River on a second lift bridge, the present new bridge being fully utilized by main-line trains. Beyond the new bridge, the piers of the old swing bridge are being removed.

The layout of the new passenger facilities is clearly indicated in this view. The station tracks are elevated, and two busy streets pass beneath the train sheds. The station building is at street level, while below street level is the terminus of the rapid-transit line built by the city in the bed of the old Morris Canal (*ENR*, Sept. 1, 1932, p. 243).

Aerial Explorations.



News Briefs

WORK ON THE CALOOSAHATCHIE RIVER section of the Lake Okeechobee flood-control project in Florida is scheduled to start in September. According to local authorities, army engineers have requested $5,780,000 to complete the flood-control work, and have stated that the project is definitely scheduled to be started this fall.

A CONTRACT FOR EXTRA WORK on a highway in Pike county, Ohio, has been declared invalid, on the ground that the work was not advertised and the contract was not let upon a competitive basis. The state auditor, who sought the opinion, told the attorney-general that he was holding up a voucher, containing the item in question, for $3,220. The attorney-general stated that there is no provision authorizing the director in case of an emergency to dispense with advertising where there is no unit price bid covering the item or items involved and the cost exceeds $2,000.

TVA OFFICES HAVE BEEN OPENED in Paris, Tenn., for the contour surveys on the Aurora Dam work. Work being done out of these temporary headquarters consists of marking contour lines for the lake and determining which lands will have to be taken for overflow.

THE CANAL AUTHORITY OF FLORIDA, created in the last legislative session, has named a committee to obtain options through Marion County for the right of way of the proposed cross-Florida ship canal. The Marion County segment is the longest in the proposed right of way, and the committee is authorized to take option in the name of the canal authority on a strip 38 miles long and one mile wide.

OBJECTIONS BY NORTH JERSEY MUNICIPALITIES caused senate bills authorizing New Jersey to enter into agreements with New York and Connecticut to check pollution of New York harbor and adjacent waters to be left on the calendar of the assembly with no action taken. Fear of large expenditures for sewage disposal plants which might be ordered by the tri-state commission to be set up by the bills led to strong opposition.

CONSTRUCTION OF THE FOURTH TUNNEL of the Figueroa St. project in Los Angeles, Calif., was begun on May 6 by the three firms which were awarded the contract on the joint bid of $366,607.07. The tunnel will be 755 ft. long, with a roadway of 40 ft. and one 5 ft. sidewalk, forming the final tunnel in the North Figueroa extension improvement from Second St. to Pasadena Ave. The extension will provide northeast Los Angeles and Glendale with a new highway to downtown Los Angeles.

CONSTRUCTION WORK ON THE LEVEES and flood-prevention project along the White River between College Ave. and Kessler Blvd., Indianapolis, Ind., will be completed in the next few weeks, according to the city engineering department. The new levee, on the south bank of the river, is 1½ miles long and about 20 ft. above the average height of the river. All construction work on the project has been done by FERA workers under the city engineers. Some 800 men have worked on the project daily since the work was started in Dec., 1933.

SOCIETY CALENDAR

AMERICAN INSTITUTE OF ARCHITECTS, annual convention, Milwaukee, Wis., May 28-30. THE PRODUCERS' COUNCIL will hold its 12th annual meeting in connection with the Institute meeting.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Detroit, June 24-28.

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual convention, Los Angeles, July 3-5.

NEW YORK STATE SOCIETY OF PROFESSIONAL ENGINEERS, annual meeting, New York, May 18, 1935.

PENNSYLVANIA SEWAGE WORKS ASSOCIATION, annual meeting, State College, Pa., June 24-26.

BOSTON SOCIETY OF CIVIL ENGINEERS at the annual meeting made the following awards:

The Desmond FitzGerald Medal to DR. GLENNON GILBOY;

The Sanitary Section Prize to ARTHUR L. SHAW;

The Clemens Herschel Prize to DR. LEO JURGENSON.

STATE EXAMINATIONS for registration of engineers and land surveyors are scheduled to be held in the near future as follows:

MINNESOTA—By the Board of Registration for Architects, Engineers and Land Surveyors at St. Paul, Minn., June 17, 1935.

FLORIDA—By the State Board of Engineering Examiners. Examinations held in each county seat where applications are filed, June 6-8, 1935.

NEW YORK—By State Board of Engineering Examiners at Albany, Buffalo, New York, and Syracuse, June 24-26, 1935.

SOUTH CAROLINA—By the State Board of Engineering Examiners at Columbia, July 9. Applications must be filed with the secretary ten days in advance of the meeting.

Personals

VAN T. MOON has been appointed chief engineer of the Oklahoma state highway department. Mr. Moon, a construction engineer of Tulsa, was at one time associated with Gov. Marland in the oil business.

CLYDE L. ANDERSON, county surveyor of Bonneville county, Idaho, has left that position to become assistant soil erosion specialist with the Soil Conservation Service in Safford, Arizona.

THOMAS H. ALLEN, engineer of Memphis, Tenn., has been named the head of the city's light and water division. This board is to install and operate TVA power when it arrives here and to continue the functions of the city water department.

BERTRAM D. TALLAMY, member of the engineering firm of Fretts, Tallamy & Senior, Buffalo, N. Y., has been appointed assistant engineer of the Niagara Frontier Planning Board.

FRANK C. DICKEY has been made city manager of Hollywood, Fla. Mr. Dickey, a civil engineer, was instrumental in planning the city when it was founded and laid out about ten years ago. At the time of his appointment Mr. Dickey was serving as city engineer.

LEON E. PHELPS, Pavilion, N. Y., acting superintendent of highways of Genesee county since the retirement of WILLIAM M. TORRANCE, has been appointed superintendent for a four year term. Mr. Phelps served as assistant superintendent for five years under Mr. Torrance.

FRANK H. FOY has been appointed director of the National Emergency Council in Massachusetts, which is to pass upon all PWA and ERA public works projects under the federal relief-works appropriation fund.

CAPT. A. C. LIEBER, engineer in charge of the Dover, Ohio, area of the Muskingum conservancy district, has established his offices at Dover. Capt. Lieber will have charge of the Beach City, Dover, Bolivar and Atwood dams in the district's flood-control program.

JOHN F. SKINNER has been elected to honorary membership in the Rochester Engineering Society. Mr. Skinner is the second member to receive this honor. Mr. Skinner is a charter member of the society and served as secretary for thirteen years and as president for one and one-half years.

LLOYD W. STRAYER has been appointed chief civil engineer of the Pittsburgh Limestone Corp. with whom he has been associated since 1920. Mr. Strayer graduated from Purdue University in 1908 and was in the service of the Baltimore and Ohio R. R. from 1918 to 1920.

H. M. RILEY, sanitary engineer of Albany, has been appointed sanitary engineer for the Tompkins county state health district with headquarters at Ithaca, N. Y. Mr. Riley, who will be attached to the staff of Dr. V. A. Von Volkenburg, will have supervision and inspection of all water and sewerage systems in that county and of general sanitation.

HARRY D. WILLIAR, JR., who has been chief engineer of the Maryland State Roads Commission since 1928, will leave the post on May 15. Mr. Williar first became associated with the commission in 1907. In 1912 he left to become assistant engineer with the paving commission of Baltimore. He served with the army in France from 1917 to 1920 and later returned to the state roads commission.

WILLIAM H. PENFIELD has been appointed chief engineer of the C.M.St.P.&P. R.R. with headquarters in Chicago. Mr. Penfield entered the service of the Milwaukee as a resident engineer in 1899. In 1903 and 1904 he was a locating engineer on the Western Pacific and then returned to the Milwaukee in charge of locating and constructing the line from Mobridge, S. D., to Seattle. In 1920 Mr. Penfield was made maintenance of way engineer. He succeeds C. F. LOWETH who has been appointed consulting engineer.

MAJ. MILO P. FOX, a member of the Board of Engineers for Rivers and Harbors, in Washington, D. C., has been assigned to the office of the Northwest Division of the Army Engineers at Portland, Ore., to take charge of one of the two districts into which the Portland District has recently been divided. Major Fox will take charge of District No. 1. District No. 2 will be under the direction of MAJ. CHARLES F. WILLIAMS who formerly had charge of the entire Columbia district. Both districts remain under the jurisdiction of Col. Thomas M. Robins, division engineer.

Obituary

JOHN F. HORR, 56, deputy director of the division of buildings, Buffalo, N. Y., died May 9, at his home in that city. Mr. Horr was a graduate of Canisius College and had long been active in building activities in Buffalo.

WILLIAM H. BEATTIE, for many years a prominent building contractor in southeastern New England, died at his home in Fall River, Mass., on May 10 after an illness of two years.

FRANCIS E. TORMEY, 70, an architect in Baltimore for many years, died there May 2. For a number of years he was assistant building engineer of the city. Prior to holding this position Mr. Tormey was city architect. He taught architecture at Maryland Institute for 25 years and designed many important Baltimore buildings.

JOHN W. PARET, 45, civil engineer connected with the U. S. Forestry Service in Jackson, Miss., died there May 7 after a brief illness. Mr. Paret, born in Linden, Md., received his engineering degree at the University of Texas. He had been with the U. S. government twenty years and came here recently from Brookhaven, Miss.

OTTO J. AMBERG, Spokane general contractor, died on May 2 at his home. He was 56 years of age. Mr. Amberg had served as president of the Northwest Branch, Associated General Contractors of America and until a few months ago was president of the Standard Asphalt Paving Co. During the last 25 years he handled many large construction projects in the Northwest.

JAMES F. POWERS, 57, a director of the New England Road Builders Association, died at his home in Brockton, Mass., May 6, after a brief illness. Mr. Powers joined with his brother, William H. Powers, in forming the contracting firm of Powers Brothers in 1901. He served the city of Brockton in 1931 as superintendent of streets, and later as a highway commissioner. He served the association as a director and as a member of the legislative committee during the past two years.

ARTHUR IRVING PLAISTED, formerly superintendent of locks and bridges for the Metropolitan District Commission at Boston, Mass, and for many years on the engineering staffs of the Charles River Basin Commission and the District Commission died at his home in Somerville, Mass., May 12 at the age of 73.

DR. ALFRED E. BURTON, first dean of the Massachusetts Institute of Technology, died at Gloucester, Mass., on May 11. He was born in Portland, Me., 78 years ago and was graduated from Bowdoin College in 1878. Dr. Burton served as dean at M.I.T. from 1902 to 1920, and upon his retirement was made professor emeritus of topographical engineering. In 1896 Dr. Burton headed an expedition to Greenland to establish new magnetic and pendulum stations. He was an honorary fellow of the American Academy of Arts and Sciences.

CONSTRUCTION STATISTICS OF THE WEEK

HIGHER private awards bring this week's volume of engineering construction to $21,680,000, compared with $17,460,000 last week. Private awards totaled $9,688,000. Public awards totaled $11,992,000, of which $10,531,000 was state and municipal work and $1,461,000 was federal construction. Federal awards are the lowest this year.

Increases are recorded in waterworks at $1,972,000; industrial buildings at $5,993,000; commercial buildings at $2,288,000; public buildings at $3,874,000; private bridges at $275,000; unclassified, public, at $1,057,000 and private, at $1,132,000.

The larger contracts for the week include a byproduct coke plant for the Ford Motor Co. at Dearborn, Mich., $4,000,000; boiler house for the Carbide & Chemical Corp. at South Charleston, W. Va., estimated at $650,000; corewall at site of the main dam at Quabbin Reservoir, Swift River, for the Metropolitan Water Supply District of Boston, Mass., $1,331,000; 16,880 tons steel rails for the Erie R.R., Cleveland, Ohio, estimated to cost $608,000.

State and municipal bond sales totaled $5,551,000 for the week. Federal allotments for the week from PWA funds total $460,000.

CONTRACTS
(Thousands of Dollars)

	Weekly Average May 1934	Week Prev. 4 Weeks	May 16 1935
Federal Government	$3,144	$2,659	$1,461
State and municipal	14,597	11,605	10,531
Total public	$17,741	$14,264	$11,992
Total private	5,607	6,377	9,688
Week's total	$23,348	$20,641	$21,680

Cumulative to date:
1934...$554,405,000 1935...$481,764,000

NEW PRODUCTIVE CAPITAL
(Thousands of Dollars)

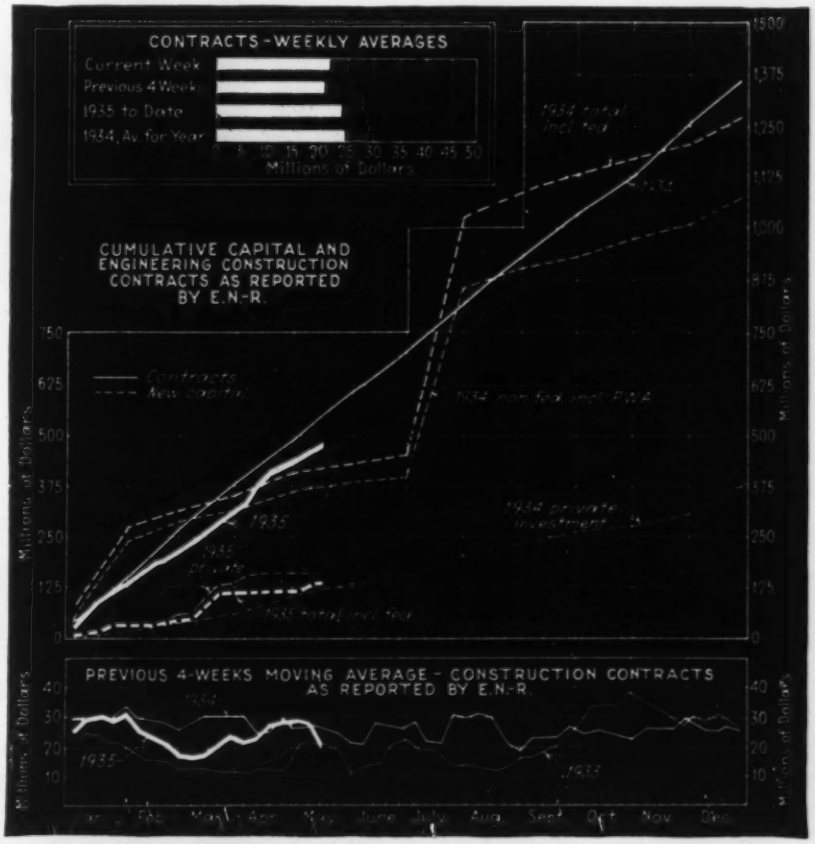
1935	Week May 16	Cumulative
State and municipal	$5,551	$158,300
PWA allotments, S&M	—1,878	—44,519
RFC loans, S&M	....	84
Corporate issues	....	....
PWA allotments, private	+110	8,619
Total, Non-Federal	$3,783	$122,484
PWA allotments, Federal Constr.	460	9,049
Total new capital	$4,243	$131,533

Cumulative to date:
1934...$416,874,000 1935...$131,533,000

Note: These figures include private bonds, and stocks sold for productive purposes; state and municipal bonds for construction; PWA loans and grants to states and municipalities, including the special highway funds; PWA private loans, and allotments for Federal construction. Negative amounts in PWA totals indicate excess of rescissions and reductions over reallotments and increases in outstanding allotments.

INDEX NUMBER

E.N.R.-Cost	1913 = 100	1926 = 100	E.N.R.-Volume	1913 = 100	1926 = 100
May, 1935	194.06	93.28	Apr., 1935	130	57
Apr., 1935	194.50	93.49	Mar., 1935	106	44
May, 1934	199.61	95.95	Apr., 1934	109	48
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50
1933 (Av.)	170.18	81.80	1933 (Av.)	102	47
1392 (Av.)	156.97	75.45	1932 (Av.)	127	56



Construction Equipment and Materials

Automatic Indicator Measures Horizontal Movement of a Point

For measuring deflections of tall structures, such as buildings or dams, a new instrument known as a Coordimeter has been developed by A. Huggenberger, Zurich, Switzerland, and is being sold in this country by the Baldwin-Southwark Corp., Philadelphia, Pa. The instrument automatically measures the horizontal movement of a plumb line attached to the structure at a considerable height above

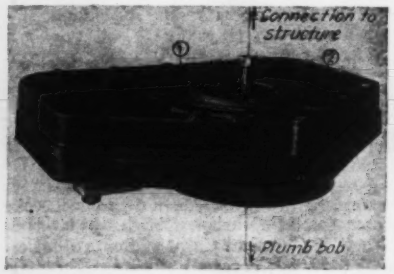


Fig. 1—New instrument that measures movement of a plumb line, permitting easy plotting of deflector curves.

the instrument. By using a number of plumb lines attached at different elevations, change in shape of the axis of the structure can be accurately determined. Corrections for temperature variations between the time of beginning an observation and completing it must be made, but otherwise the instrument is completely automatic.

The instrument is shown in Fig. 1 and its construction is explained in Fig. 2. Referring to Fig. 2, the Coordimeter consists of the base with the length c. The end points, A_1 and A_2 are the centers of rotation of the pointers b_1 and b_2. The two pointers rest with a very small pressure against the wire, Q, whose section is equivalent to the point P_o. The angles between the pointers b_1

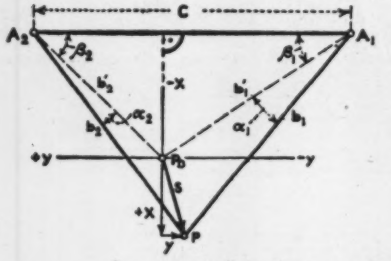


Fig. 2—Trigonometric relationships in operation of Coordimeter.

and b_2 and the base c are B_1 and B_2 respectively. Point, P_o, is the origin to which the further movement is referred. If the wire to which a plumbbob is attached shows a deflection s from P_o to P, the angles of the pointers are altered by α_1 and α_2 respectively. In practice the Coordimeter is constructed with angles B_1 and B_2 equal to 45 deg. The angles α_1 and α_2 are then read directly (in radians), and a simple calculation (or a tabulation) gives the coordinate values x and y.

The Coordimeter shown in Fig. 1 has a range of 30 mm. and an accuracy of reading of 0.05 mm. The dial plates 1 and 2 are supplied with metric or inch divisions. With some practice the readings can be made with a precision of 0.1 mm. or 0.004 in. Coordimeters can be built in such a way as to transfer the readings to a central station. For example, the indicator might be placed in the turbine house so that the deflection of the top of the dam can be observed at the same time as the height of the water level.

New Sludge Dewatering Unit for Small Communities

The development of an assembled sludge dewatering unit for smaller communities of approximately 10,000 population has been achieved by Oliver United Filters, Inc., New York.

The unit is complete including all accessory equipment and interconnecting piping ready for installation. Three sizes are available, 18, 36 and 54 sq.ft. Overall height is less than 9 ft. It usually can be installed in existing buildings.

Each unit includes sludge mixing tanks, either batch or continuous type, to effect the proper introduction of chemicals. These units also can be mounted on a truck to serve as a portable unit for two or more disposal plants.

This Oliver assembled sludge dewatering unit is designed to give to smaller communities the advantages of mechanical dewatering of sludge. Operation is independent of weather conditions and costs are relatively low, and the expense of filter beds is saved.

New Equipment in Brief

Self-Priming Pump. An automatic centrifugal pump that primes itself without floats or recirculation has recently been developed by the Worthington Pump and Machinery Corp., Harrison, New Jersey. The self-priming has been attained by a positive primer on the same shaft as the motor and pump. A pressure-operated cutout automatically unloads the primer, making valves and floats unnecessary.

Definite Purpose Trucks. The Hug Co., Highland, Ill., makers of Hug Roadbuilder trucks, has added a new series of 1½- to 5-ton "Definite Purpose" motor trucks. Each type of truck is built specifically for the work to which it is to be put, just as the Roadbuilder model is designed expressly for roadbuilding. The new trucks are made in five weight capacities with three models in each class: Model A for commercial hauling; Model D for dump truck work and Model T for tractor hauling. A patented front-axle rocker action is used to allow free motion to each front wheel to reduce strain on the chassis members.

Two Stage Air Compressor. Schramm, Inc., West Chester, Pa., has developed a two-stage air compressor, suitable for belt or motor drive, with straight line construction. Low pressure and high pressure cylinders are cast in one block with an intercooler to reduce the air temperature close to atmospheric. The straight line construction is designed to increase efficiency by providing a more even distribution of wear. These compressors are equipped with the Schramm detachable block to facilitate adjustments and inspections.

Vibrating Drive Unit. The Shaler Shaker, manufactured by the Ajax Flexible Coupling Co., Westfield, N. Y., is a device to replace the common eccentric drive in imparting a horizontal screening motion to a sieve of a conveyor for sand, gravel, or other dry material. This vibrating drive unit has two weights geared together so that they rotate at the same speed but in opposite directions. The unit can be either belt or motor driven. All the mechanism is enclosed in a dustproof and oilproof case insuring efficient performance.

Business Notes

BUCYRUS ERIE CO. has moved its New York Office to the RCA Building, Rockefeller Center.

D. E. FRYER & CO., Textile Tower, Seattle, have been named western Washington distributors for Palco cold storage and house insulation, a product of the Pacific Lumber Co. of San Francisco.

WILLIAM B. TODD, general manager of sales of the Jones and Laughlin Steel Corp. since 1931 was elected vice-president in charge of sales at the annual meeting of stockholders. F. E. FIEGER, who since 1929 has been general manager was elected vice-president in charge of operations, and F. R. MILLER was elected vice-president in charge of sales of the Consolidated Expanded Metals Companies.

DANA G. GRIFFIN, sales representative in Texas for the Bruce-Macbeth Engine Co., Cleveland, Ohio, died recently. GEORGE M. WILLIAMSON will take over the work of Mr. Griffin.

VICTOR J. MILL of Baldwinsville, N. Y., has purchased the Lawrence Machine & Pump Corp. of Lawrence, Mass., and will continue to operate it under that name. The company was established in 1882. Mr. Mill plans to continue the "Lawrence" line of pumps with many new improvements in design. The line will include centrifugal pumps, single and multi-stage water pumps, sewage and sludge pumps, slurry pumps and dredging pumps. In addition the plant will build hydraulic dredges and special machinery.

New Publications

SUGGESTIONS FOR GALVANIZED SHEET METAL SPECIFICATIONS, The American Rolling Mill Co., Middletown, Ohio. 8½ x 11, 8 pages.

SIZES OF SHEARED OR FLAME-CUT PLATES, Lukens Steel Co., Coatesville, Pa. 8½ x 11. Size card for sheared and rolled steel plates.

TRANE PRODUCT COOLERS, The Trane Co., La Crosse, Wisc. 8½ x 11, 4 pages.

TRANE FANS, The Trane Co., La Crosse, Wisc. 8½ x 11, 24 pages. Fans for heating, ventilating, drying, and air-conditioning.

METAL LATH SPECIFICATIONS, Metal Lath Manufacturers Association, Chicago, Ill. 8½ x 11, 24 pages. Revised specifications for metal lath.

ADAMS MOTOR GRADERS, J. D. Adams Co., Indianapolis, Ind. 8½ x 11, 15 pages.

MUREX ELECTRODES, Metal and Thermit Corp., New York, N. Y. 8½ x 11, 16 pages. Booklet No. 2.

PROCESSED KYROCK, Kentucky Rock Asphalt Co., Louisville, Ky. 8½ x 11, 16 pages.

ENDURO STAINLESS STEEL FOR TEXTILE EQUIPMENT, Republic Steel Corp., Massillon, Ohio. 8½ x 11, 6 pages. Form ADV 146.